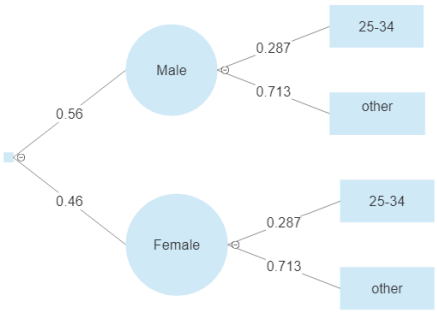
Assessment Schedule – 2023

Mathematics and Statistics: Demonstrate understanding of chance and data (91037)

Evidence

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)(i)	18.8 % + 10.9 % = 29.7 % or 0.297	• Correct answer.		
(ii)	Prob (female and 25–34) = 0.46 × 0.287 = 0.132 OR  	• C.A.O. OR Partial tree diagram.	• Correct probability, with working.	
(iii)	• Expected value = 63 × 0.188 = 11.84 The expected number of aged 55+ users is 12 people. (Allow 11 people; Allow 11 or 12 people; Allow about 12 people.) .Niko's percent is 12.6% • Because the sample size is quite small out of the huge number of Spotify users, Niko should expect to see quite a large variation. • The result of 8 Spotify users is only 3 Spotify users less than the expected value of 11 Spotify users. • Niko's claim is correct, as this small difference between his result and the actual expected value is an acceptable variation within his relatively small sample size. • Candidate queries whether the sample chosen by Niko is actually a representative random sample as the survey members have been selected from only Nico's family and work colleagues. This selection may cause bias in the results.	• Stating sample size is quite small. OR The sample may have possible bias.	• Calculated expected value. OR Calculating probabilities	**T1 / E7** As for r AND Discussed the large sampling variability based on small sample size. OR Discussed issues regarding the sample selection and possible bias.

(b)(i)	Feb 2017, when there were approximately 185-195 million users.	• Correct answer, with some evidence.		
(ii)	**Trend** The long-term trend has increased from approximately 210 million users in May 2016 to just over 280 million users in Aug 2020. **Unusual** • There is a large spike in late 2017, jumping from 190 million users in Feb to all time high of 320 million users in Dec 2017. • A second noticeable spike was in Dec 2019, reaching around 287 million users. • Do not accept any reference to non-existent repeating patterns. • Irregular scale. • No obvious seasonality.	• Any one sensible feature identified. Accept omission of justification.	• Any two sensible features identified, with attempt to justify.	**T1 / E7** Two valid features with clear numerical evidence, justification, units. **T2 / E8** Gaining T1 AND identifying a grade r – quality misleading feature on the graph (part (iii)). OR Three valid features with clear numerical evidence, justification, units.
(iii)	The timeline is not on a linear scale (regular interval). The vertical scale starts at 175, but scales should be starting at 0. Because the vertical scale starts at 175, this would have the effect of exaggerating the actual rises in the data. Accept other non-trivial valid comments.	• Identifying a non-trivial valid comment relating to the graph being misleading.	• Identifying two non-trivial valid comments relating to the graph being misleading.	

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	One question part attempted.	1u	2u	3u	1r	2r	1t	2t

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
TWO (a)(i)	$\frac{17}{68}\times\frac{17}{68}=\frac{1}{16}=0.0625$ OR $\frac{17}{68}\times\frac{16}{67}=\frac{4}{67}=0.0597$ OR $0.25\times0.25=0.0625$	• Recognised the need to use $\frac{17}{68}$ or 0.25.	• Correct probability. (Allow sampling with or without replacement.)	
(ii)	**Centre** The median of pop music tempo is 123 bpm, which is higher than the classical music tempo of 97 bpm **Shift / Overlap** The middle 50% box for the pop music tempo is further up on the scale than the classical music tempo (must state values). There is some overlap between the two middle 50% boxes (must state values). **Shape** The distribution of pop music tempo is almost symmetrical, whereas the classical music tempo is slightly right skewed. **Spread** The IQR of classical music is 57 bpm compared to 45 bpm for pop music. OR Range classical 142, pop 136 **Clusters** Identifying classical at 70-90 **Unusual point (outlier)** 199 (or 198) for classical	• ONE significant feature compared.	• TWO different significant features compared, with some numerical evidence included.	• THREE different significant features compared, including appropriate relevant numerical evidence.
(iii)	Thom's claim is false because pop music tempo tends to be faster / higher than classical music tempo on Spotify, because the median tempo of classical music (97 bpm) is lower than the LQ tempo (102 bpm) of pop music, AND including numerical justification. I am confident in my conclusion because the sample size is big enough for me to use ½ and ¾ rule. OR Thom's claim is false, however, I am not very confident because the median is only just outside the pop music middle 50% box. Sampling variability suggests that a different sample may show both medians within each other's box, in which case Thom would be correct. (Do not accept that the sample size is not sufficiently large.)	• Rejected claim with a valid attempt to justify.	• Decision that the claim is false, including a correct conclusion, with reasoning based on classical median outside classical box OR DBM/OVS	• Response as in Merit, including supporting numerical justification. AND Confidence level is clearly discussed.

(b)(i)	$\frac{1-570}{1000}=\frac{430}{1000}=\frac{43}{100}=0.43$	• Correct answer.		
(ii)	Because the **sample size** of the graph is 1000 is large enough to allow an estimate for the centre of graph, I would expect to see a **similar** distribution.	• Similar distribution, with ONE distribution feature. OR New sample is likely to have 4 slow, 110 medium, 60 fast, 26 very fast pop songs. OR Sample size discussed.	• Similar distribution, with examples AND Sample size discussed	

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	One question part attempted.	1u	2u	3u	1r	2r	1t	2t

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
THREE (a)(i)	Danceability score value that is approximately 0.6. Allow the response given as a range, e.g. score would be between 0.3 to 0.7. Allow indicated on the graph. Allow evidence of averaging the 3 or 4 data points for the score of 0.1. I am not confident in this result because there are only 3 results for the score of 0.1 and they have a big variation.	• Valid answer.	• Valid answer for the expected "Danceability" score. AND Comment expressing a lack of confidence in the prediction with valid reasoning.	
(ii)	There appears to be a positive linear relationship. as "Happy music" score increases then so does the "Danceability" score. The relationship is weak, because the points are scattered away from the line of the best fit. Accept there is no relationship.	• One statement made for the relationship, with some valid justification.	• TWO statements made for the relationship, in context, with valid justification.	
(iii)	**Overall**, as the relationship is weak, I would not be very confident in my predictions from these results. **But**, I would be more confident to predict a danceability score for music with "Happy music" score higher than 0.75. Because the points are much **closer to the line of best fit** between 0.75 and 1 (showing a stronger relationship) than below 0.4. **But**, I would be reluctant and very unconfident to predict a danceability score for music with "Happy music" score less than 0.4. Because most of the points are **scattered away from the line**. This section is showing the weakest relationship.		• Correct conclusion, with some correct justification. E.g. The relationship is weaker between 0 and 0.4.	• Correct conclusion, made with clear comparison of at least two sections AND with supporting justification.

(b)(i)	$\frac{92}{500} = \frac{23}{125} = 0.184 = 18.4\%$	• Correct probability.		
(ii)	Prob(less than 2 hours, given a free subscription) $= \frac{40}{200} = 0.2 = 20\%$ Prob(less than 2 hours, given a premium subscription) $= \frac{21}{300} = 0.07 = 7\%$ Must have valid numerical reasoning, e.g. because 0.2 > 0.07 or 20 % > 7 % It is more likely that free subscribers will use less than 2 hours per week compared to the premium subscribers, because the proportion / probability / percentage of free subscribers is much higher than that of the premium subscribers.	• ONE conditional probability calculated.	• TWO conditional probabilites calculated.	• Both probabilities correct AND compared AND fully justified with conclusion made.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	One partial solution	1 of u	2 of u	3 of u	1 of r	2 of r	t1	t2

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 14	15 – 19	20 – 24