

Assessment Schedule – 2013

Mathematics and Statistics (Statistics): Evaluate statistically based reports (91584)

Assessment Criteria

Achievement	Achievement with Merit	Achievement with Excellence
<p><i>Evaluate statistically based reports</i> involves identifying and commenting on key features in reports relevant to any conclusions made in those reports.</p>	<p><i>Evaluate statistically based reports, with justification</i> involves supporting the comments made by referring to statistical evidence and processes used in reports, relevant to conclusions made in those reports.</p>	<p><i>Evaluate statistically based reports, with statistical insight</i> involves integrating statistical and contextual information to assess the quality of reports with respect to conclusions made in those reports.</p>

Evidence Statement

One	Expected Coverage	Achievement (c)	Merit (j)	Excellence (i)
(a)(i)	<p>The reported margin of error is</p> $\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{400}} = 0.05 \text{ or } 5\%$ <p>Allow $1.96\sqrt{\frac{0.5 \times 0.5}{400}} = 0.049$, which rounds to 0.05 (2 d.p.).</p> <p>Allow $1.96\sqrt{\frac{0.54 \times 0.46}{400}} = 0.0488$, which rounds to 0.05 (2 d.p.).</p> <p>Allow 0.05 $2\sqrt{\frac{0.5 \times 0.5}{400}} = 0.05$.</p> <p>The margin of error is needed to take into account the variation in survey percentages due to sampling.</p>	<p>Demonstration of how the margin of error is calculated.</p>	<p>Demonstration of how the margin of error is calculated AND its use for interpreting survey percentages is clearly explained.</p>	
(ii)	<p>A 95% confidence interval for the survey percentage of 54% is $54\% \pm 5\%$ or [49%, 59%].</p> <p>Based on this confidence interval, the claim is not supported, as the lower end of the interval is less than 50%.</p>	<p>The confidence interval is constructed for the survey percentage <u>AND</u> is used to explain that the claim is not supported.</p>		

<p>(b)</p>	<p>$n = 216$.</p> <p>The MOE rule to use when comparing a difference in survey percentages for options is:</p> $2 \times \frac{1}{\sqrt{n}} = \frac{2}{\sqrt{216}} = 0.136 \text{ (13.6 percentage points)}$ <p>The difference in the survey percentages is $0.523 - 0.363 = 0.16$ (16 percentage points).</p> <p>As the MOE is smaller than the difference in the survey percentages, the claim is justified.</p> <p><i>Allow construction of a confidence interval for the difference between two dependent proportions, e.g. $16\% \pm 13.61\% \rightarrow [2.39\%, 29.61\%]$, i.e. $[2.4\%, 29.6\%]$, and the interpretation that, as the lower end of the interval is above 0, the claim is justified.</i></p> <p>OR</p> <p>Decrease cost of clothing CI = $52.3\% \pm 6.8041\%$ i.e. $[45.496, 59.1041]$</p> <p>Reduce pressure to wear “cool” clothes CI = $36.3\% \pm 6.8041\%$ ie $[29.496, 43.104]$</p> <p>A comparison is made illustrating that the Decrease cost of clothing CI and the Reduce pressure to wear “cool” clothes CI, have a gap (no overlap) of 2.39%.</p> <p>With the Decrease cost of clothing CI completely above the Reduce pressure to wear “cool” clothes CI justifying the claim.</p>	<p>The margin of error is correctly calculated for the subgroup ($n = 216$) AND the difference between the two survey percentages of the options is calculated.</p> <p>OR</p> <p>The two margin of error are correctly calculated for the subgroups ($n = 216$) AND a ‘no overlap’ statement is made.</p>	<p>The margin of error is correctly calculated AND used to explain that the claim is justified.</p>	
<p>(c)</p>	<p>As the survey was conducted during the week of 23 July – 30 July, it’s possible that if the weather was cold during this week (as it is during winter), this may have influenced people’s responses, as winter clothing is more expensive than summer clothing.</p> <p>The survey was conducted over the telephone, and so excluding those with no phones..</p> <p>This exclude sub-group(s) of the NZ population who do not have access to phones and whose opinions on the wearing of school uniforms may be different.</p> <p>The survey was conducted with people aged 18 years or over. However, the claim is made about all Kiwis.</p> <p>The opinions of current school students would not be included as they are not part of the sample, so the survey would be biased towards adults’ opinions on school uniforms.</p>		<p>At least two possible non-sampling errors are described</p>	<p>E7: One possible non-sampling error is described AND a reasonable example of how it could cause bias in this survey is given.</p> <p>E8: Two possible non-sampling errors are described AND a reasonable example of how each could cause bias in this survey is given.</p>

		<i>Allow other possible non-sampling errors that are relevant to the information presented in the report. e.g. parents, 'cool clothes'</i> [NOT - non-response as it is NOT disclosed in thereport or table or speculation.]						
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempt at one part of the question.	1 of c	2 of c	3 of c	1 of j	2 of j	1 of i with some incomplete statements	1 of i

Two	Expected Coverage	Achievement (c)	Merit (j)	Excellence (i)
(a)	<p>The target population is all university students in New Zealand.</p> <p>A random sampling method was used to obtain the sample of students (presumably from lists of current students from each of the universities, with their email addresses used to deliver the survey) and there was a very high response rate, which means the sample is likely to be representative.</p> <p><i>Accept other reasonable justifications for the representativeness of the sample.</i></p>	<p>Target population identified.</p>	<p>Explanation given regarding the likely representativeness of the sample.</p>	
(b)	<p>The margin of error is $\frac{1}{\sqrt{1982}} = 0.022462$, which rounds to 0.022 [2 d.p.] = 2.2%</p> <p>Allow $1.96\sqrt{\frac{0.5 \times 0.5}{1982}} = 0.022127$, which rounds to 0.022 [2 d.p.]</p> <p>Allow $1.96\sqrt{\frac{0.41 \times 0.59}{1982}} = 0.0217$, which rounds to 0.022 [2 d.p.]</p> <p>Allow $2\sqrt{\frac{0.5 \times 0.5}{1982}} = 0.02246$, which rounds to 0.022 [2 d.p.]</p> <p>A 95% confidence interval for this survey percentage is [38.8%, 43.2%]</p> <p>With 95% confidence, I estimate that the percentage of New Zealand university students who spend at least 10 hours a week in a part-time job is somewhere between 38.8% and 43.2%.</p> <p>OR</p> <p>Based on this sample at the 95% CI...</p> <p>[Note: % symbol not required, due to question wording.]</p>	<p>Margin of error correctly calculated <u>OR</u> confidence interval correctly calculated.</p>	<p>The confidence interval is correctly calculated <u>AND</u> used to make an appropriate inference.</p>	
(c)	<p>“Will you spend your holidays working full-time so you can cover your university fees and accommodation costs?”</p> <p>This question is a “double-barrelled” question that only allows for one answer, although it is asking about the costs of both university fees and accommodation. This means the responses might not be accurate, as people might be saying “yes” to only one of the costs, but there is no way to know this from their response.</p> <p>OR</p> <p>“Would you agree that some form of financial stress during the year caused you not to achieve the grades you could have?”</p> <p>The question is very subjective, as people are left to make up their own minds as to what might be considered forms of financial stress, as these are not clearly defined in the question. The question is also based on a causal-relationship claim, which makes it very leading.</p>	<p>One potential difficulty with the wording of one of the survey questions listed is described.</p>		

	<p>OR</p> <p>“What was your GPA this year?”</p> <p>Students not being able to recall their GPA score accurately giving inaccurate numerical results (Quantitative data)</p> <p>OR</p> <p>“How many hours do you spend in part-time work each week?”</p> <p>Students hours of work could vary in work related activities from week to week and could not give an accurate number of hours worked (Quantitative data)</p> <p><i>Other potential difficulties are possible.</i></p>							
(d)	<p>The results from the questions “What was your GPA this year?” and “How many hours do you spend in part-time work each week?” could have been used to construct a scatterplot, with hours spent in part-time work as the explanatory variable and GPA as the response variable.</p> <p>A linear model would be fitted to the data, and the gradient of this model would have been used to quantify the relationship between hours of part-time work and GPA.</p> <p>To evaluate this claim, you would need to know the strength of the linear relationship between these two variables, or the confidence interval for the gradient, assuming that a linear model is an appropriate model for the data.</p>			<p>The use of bivariate data and a linear model as part of the process is identified.</p>	<p>The explanatory and response variables are described <u>AND</u> the gradient of the linear model is linked to the claim / inference made.</p>	<p>The explanatory and response variables are described.</p> <p>The gradient of the linear model is linked to the claim / inference made.</p> <p>The need to assess the strength of evidence is discussed, in terms of being uncertain about the amount of variation.</p>		
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempt at one part of the question.	1 of c	2 of c	3 of c	1 of j	2 of j	1 of i with some incomplete statements	1 of i

Three	Expected Coverage	Achievement (c)	Merit (j)	Excellence (i)
(a)	The explanatory variable is the amount of time spent in the sun. The response variable is the rating of their happiness.	The explanatory and response variables are correctly identified and described.		
(b)	<p>This is an observational study because there was no intervention – the researchers did not decide how long each person in each group should be exposed to the sun for.</p> <p>The groups for comparison (low exposure and high exposure) were formed from the results of the study, not by random allocation prior to the study commencing.</p> <p>Sun exposure is also known to be associated with health risks such as skin cancer, so it would not be appropriate to force a participant to spend a high number of days in the sun.</p>	At least one explanation is given that identifies why the study is observational.	A full explanation is given, making links to the context, as to why the study is observational.	
(c)	<p>The statistical evidence presented to support the causal-relationship claim that “the more time you spend outside in the sun, the happier you will feel” is that the “high sun exposure” group has a higher mean rating for happiness than the “low sun exposure” group, a difference of 0.8.</p> <p>This evidence is not sufficient by itself, as you would need to take into account the variation of the ratings within each group is (and how many people were in each group) to make an inference about the difference between the means of the ratings of each group.</p>	The statistical evidence presented is identified as being insufficient.	The statistical evidence presented is identified AND the need for an inference method to be used to interpret the size of the difference in terms of the variation of ratings is explained.	
(d)	<p>Using the past as a source of data is a potential issue for this study, as the measurement of the number of days spent in the sun each summer is based on participants recalling this at the end of summer, as is the rating of how happy they felt. It would be better to ask participants to record which days they spent in the sun as they happen, and to complete a weekly survey about their happiness.</p> <p>Happiness could be explained by other factors related to the sun, eg the number of hours spent socialising (the number of BBQs attended outside in the sun), activities completed while in the sun (working outside versus sitting on the beach). If the nature of the activity was also recorded as well as how long each person spent in the sun, then these other factors could be taken into account in the analysis.</p> <p>Extending the results inappropriately could be an issue in this study in terms of the claim made, as the group used for the study was people aged 18 – 35 years old, but the claim does not limit the causal-relationship only to this age group. It may be that age is not a factor, and the causal-relationship exists and is similar for all age groups.</p> <p>Ensuring a wider range of age and backgrounds for the study could allow for a more</p>	Two different potential issues with this study are identified and described in reference to the main claim.	Two different potential issues with this study are discussed in reference to specific contextual knowledge relevant to the main claim.	<p>E7: One different potential issue with this study is discussed in reference to specific contextual knowledge relevant to the main claim AND used as the basis for suggestions to improve a future study in this area.</p> <p>E8: Two different potential issues with this study are discussed in reference to specific contextual knowledge relevant to the</p>

	representative cohort, which would help with extending the results. <i>Accept other reasonable potential issues, e.g. at the beach, holidays, rural vs urban, ethnicity, income, educational qualifications.</i>						main claim AND used as the basis for suggestions to improve a future study in this area.	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempt at one part of the question.	1 of c	2 of c	3 of c	1 of j	2 of j	1 of i with some incomplete statements	1 of i

Points to note:

- ‘lax’ with CI notation, but not accepting $a < proportion > b$ or variants of this notation.
- Not accepting Q1 (a) (i) ‘accurate’ or ‘reliable’
- Not accepting Q1 (c) non-response rate as it is NOT disclosed in the table or speculation statements.

Accepting:

Q2 (d) Use of diagram(s) to support judgements and insight e.g. a scatterplot is drawn, linear regression and variation of line of best fit indicated.

Coding for achieved, merit and excellence criteria for question parts

- c*- communication/calculation
- j* – judgement
- i* - insight

- Errors are circled.
- Omissions are indicated by a caret (^).
- **ns** used when there was not sufficient evidence to award a grade.
- # may have been used when a correct answer is obtained but then further (unnecessary) working results in an incorrect final answer being offered.
- **RAWW** indicates ‘right answer, wrong working’.
- **MEI** may have been used to indicate where a minor error has been made and ignored.
- **2ANS** – two answers given

Judgement Statement

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 6	7 – 12	13 – 18	19 – 24