

**Assessment Schedule 91584**

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

**Evidence Statements**

One	Expected Coverage	Achievement (c)	Merit (j)	Excellence (i)
(a)(i)	<p>The reported margin of error is</p> $\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{600}} = 0.041 = 4.1\%$ <p>Also accept <math>2\sqrt{\frac{0.5 \times 0.5}{600}} = 0.041 = 4.1\%</math></p> <p>The margin of error is needed to take into account the <b>variation</b> in survey percentages <b>due to sampling</b>.</p>	<p>Demonstration of how the margin of error is calculated.</p>	<p>Demonstration of how the margin of error is calculated <b>AND</b> its use for interpreting survey percentages is clearly explained.</p>	
(ii)	<p>The percentage of respondents who never talk to their friends on a landline from the November 2009 survey is 9%. The reported margin of error should be used as only an estimate of the margin of error with survey percentages between approximately 30% and 70%.</p> <p>This particular survey percentage is well outside this range. The margin of error for this survey percentage would be much smaller than 4.1%.</p> <p>[Calculated: <math>1.96 \times \text{moe} = 2 \times \text{moe} = 2.3\%</math>]</p>	<p>Identifies that this particular survey percentage is outside the range of 30% to 70%.</p>	<p>A full explanation as to why it is inappropriate to use the reported margin of error, which includes reference to the size of the margin of error.</p>	
(b)(i)	<p>A 95% confidence interval for the survey is <math>49\% \pm 4.1\%</math> or (44.9%, 53.1%).</p> <p>Based on this confidence interval, the claim that “fewer than half of young New Zealanders are now talking to friends on landlines regularly each week” is not supported, as the upper end of the interval is greater than 50%.</p>	<p>Upper end of the CI is stated for the survey <b>AND</b> is used to explain that the claim is not supported.</p>		

(ii)	<p>Potential difficulty with the wording of the survey question --&gt;The question asks how often a land line is used to talk to friends, not how often it is used for any reason. While the claim is just about talking to friends, it does limit the scope of the question. Since another claim made in the report is that "land line voice calls were diminishing", the question should focus on using a land line to call anyone, not just friends.</p> <p>Potential difficulty with the wording of the response categories → The response categories overlap, eg talking to friends on a landline “everyday” is included in the category “at least once a week”. Similarly, talking to friends on a landline “never” is included in the category “less than once a week”. Additionally, the categories “never” and “less than once a week” could be too close together, and it could be better to use “at least three times a week” or “less than three times a week” as the categories, so you can get a better understanding of how often landlines are being used to talk to friends. <b>[The overlapping of response categories.]</b></p>	<p>A potential difficulty identified with EITHER the wording of the survey question OR the wording of the response categories is described.</p>	<p>One potential difficulty with the wording of the survey question AND the wording of the response categories is fully described.</p>	
(c)	<p>Possible discussion points:</p> <ul style="list-style-type: none"> <li>• The five surveys were not all conducted at the same time each year. This could bias the results as some times of the year would allow more time for talking with friends on a landline, eg the school holidays.</li> <li>• There was no survey conducted in 2013. This causes bias in the interpretation of the graph presented in the report, as it appears that there has been a big decrease recently (between September 2012 and July 2014).</li> <li>• The interviews were conducted using landline and cell phone. This could cause bias as this excludes sub-group(s) of the teenage population who do not have access to phones, and who could reply “never” in response to the survey question.</li> <li>• The proportion of interviews made with either cell phones or telephones is not reported in any one year.</li> <li>• Under/over representation of telephone or cell phone users.</li> </ul> <p><i>Allow other possible non-sampling errors that are relevant to the information presented in the report.</i></p> <p><b>Note:</b> Non-response – not accepted as is not reported on in the article.</p>		<p>At least two possible non-sampling errors are described.</p>	<p>Two possible non-sampling errors are described AND a reasonable example of how each could cause bias is given.</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

Two	Expected Coverage	Achievement (c)	Merit (j)	Excellence (i)
(a)(i)	<p>Margin of error for West Auckland = <math>\frac{1}{\sqrt{210}} = 6.9\%</math></p> <p>Margin of error for South East Auckland = <math>\frac{1}{\sqrt{175}} = 7.6\%</math></p>	<p>Margin of errors of <b>each</b> group correctly calculated and identified.</p>		
(ii)	<p>Average margin of error = 7.25%</p> <p>Comparing two subgroups so margin of error for comparison = <math>1.5 \times 7.25\% = 10.8\%</math> (also accept 10.9%).</p> <p>The difference between the two survey percentages is <math>56\% - 42\% = 14</math> percentage points.</p> <p>The 95% confidence interval for the difference between the two survey percentages is (3.1%, 24.9%). Also accept a CI of (3%, 25%) or <math>14\% \pm 11\%</math>.</p> <p>I'm pretty sure that the percentage of <i>SuperInfo</i> customers in West Auckland who will agree to the name change is somewhere between 3.1% and 24.9% higher than the corresponding percentage of <i>SuperInfo</i> customers in South East Auckland. This interval supports the claim that a higher percentage of <i>SuperInfo</i> customers in West Auckland will agree to the name change than South East Auckland <i>SuperInfo</i> customers because the confidence interval is entirely positive.</p> <p><i>Note: Accept the use of the formula <math>1.96\sqrt{\frac{p_1q_1}{n_1} + \frac{p_2q_2}{n_2}}</math> to calculate the margin of error for the confidence interval. <math>1.96 \times \text{m.o.e.} = 9.9\%</math> or <math>2 \times \text{m.o.e.} = 10.1\%</math></i></p>	<p>The margin of error needed to compare two independent groups is correctly calculated.</p>	<p>The margin of error is calculated AND used to construct a confidence interval for the difference between the two independent group percentages.</p>	<p>The confidence interval for the difference between the two percentages is constructed AND is interpreted as part of the explanation as to whether the claim can be supported or not.</p>
(iii)	<p>The method used to obtain the sample was to poll customers at a large mall in this area on just one day. This method is not likely to have obtained a representative sample, as not all customers within the population had an equal chance of being selected. Only those who went to that specific mall were part of the sampling frame, and then only the ones approached at the mall (so only the ones who were interviewed by those conducting the survey).</p> <p><i>Accept other reasonable justifications for the representativeness of the sample.</i></p>	<p>The sample will not be representative is identified and described.</p>	<p>The unlikely representativeness of the sample for the target population is identified and described and explained.</p>	

<p>(b)</p>	<p>A potential issue with the company using this sampling method is that it may exclude existing or potential customers with different opinions and views of the company rebranding.</p> <p>The company has used cluster samples made up of two different potentially existing customer groups – customers who travel through airports (likely to be business customers and travellers) and customers at university (likely to be younger customers but older than 17 years).</p> <p>The company would need to be confident that these clusters are representative of all <i>SuperInfo</i> customers in order to make generalisations.</p> <p><i>Accept other reasonable explanations regarding potential difficulties.</i></p>	<p>An issue with the sampling method used is identified.</p>	<p>Explanation given as to whether the cluster groups used are likely to be representative or similar to <i>SuperInfo</i> customers in other groups not included in the surveys at these locations.</p>	
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N0	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 using social media per week (hours on social media). The response variable is the amount of time spent in physical activity per week (hours of physical activity).	The explanatory and response variables are correctly identified and described using time within the variables.		
(b)	<p>The relationship between the hours on social media and the hours of physical activity, as shown in the scatterplot presented in the article, does appear to follow a negative trend, which supports the claim that students tend to spend less time on physical activity as they spend more time on social media.</p> <p>If a linear model was fitted, the gradient would be approximately <math>-0.5</math>, which supports the claim that students tend to spend half an hour less on physical activity for each extra hour they spend on social media.</p> <p>However, the relationship between hours on social media and hours of physical activity appears to be quite weak, with a large amount of scatter visible. Additionally, the relationship also appears to be non-linear, with the hours of physical activity not decreasing by much beyond 10 hours on social media.</p>	<b>At least one feature</b> of the relationship between the hours on social media and the hours of physical activity, as shown in the scatterplot presented in the article, is used to support or reject the claim made, e.g. direction, rate of change, type of relationship (linear, non-linear), strength of relationship.	<b>At least two features</b> of the relationship between the hours on social media and the hours of physical activity, as shown in the scatterplot presented in the article, are used to support or reject the claim made, e.g. direction, rate of change, type of relationship (linear, non-linear), strength of relationship.	
(c)	The heading of the article makes a causal claim that the amount of time a student spends on social media is <b>affecting</b> their fitness level. However, as this is an observational study, causal claims should not be made, as there may be other variables that are linked to physical activity that have not been controlled for the study.	Identification that this study is an observational study OR Identification of a causal claim in heading.	Explanation of why this is an observational study (which links to the context) and the limitation this has on making a causal relationship claim.	

<p>(d)</p>	<p>Possible discussion points:</p> <ul style="list-style-type: none"> <li>Using the past as a source of data → to collect data for each of the variables, the researchers would have to rely on the participant’s memory, as each student was interviewed only once. This could be a problem, as it is hard to keep track of how much time has passed when you are engaged in something (like chatting on Facebook). To manage this for the future, students should be asked to keep a log of how many hours they use social media over a week as they use it.</li> <li>Confounding variables → there are other variables linked to using social media and physical activity. For example, the amount of time available each week to spend on either using social media or doing physical activity may vary for each student depending on their situation (eg, part-time jobs, workload from school), lifestyle factors such as whether the student’s family has access to the internet or exercise facilities. The age of the participants in the study would also be quite varied (secondary school students ranging in age from 12 to 18 years old), which also would be linked to how much time they spend in physical activity or on social media (eg, junior students having PE as a compulsory subject). If data for other related variables was also collected, then these other factors could be taken into account in the analysis.</li> <li>Extending the results inappropriately → the research was conducted with students in New Zealand, Australia and the UK, although the report does make claims about all “youngsters” or secondary school students. This may be a problem as students in other countries may not have the same opportunities to access social media. To manage this for the future, a greater selection of countries should be used in the research, or the results should be applied only to a specific country or countries. Extending the social media time results further would indicate a negative amount of time on physical activity (impossible!).</li> </ul> <p><i>Accept other valid discussion points</i></p>	<p>At least one potential issue with this study are identified AND described in reference to the main claim.</p>	<p>At least two different potential issues with this study are identified AND both are described in reference to the main claim.</p>	<p>At least two different potential issues with this study are 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>
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**Cut Scores**

	<b>Not Achieved</b>	<b>Achievement</b>	<b>Achievement with Merit</b>	<b>Achievement with Excellence</b>
<b>Score range</b>	0 – 7	8 – 12	13 – 18	19 – 24

The following Statistics-specific marking conventions may also have been used when assessing this paper:

- Coding for achieve, merit and excellence criteria for question parts:
  - c* – communication/calculation
  - j* – judgement
  - i* – insight.
- Errors are circled.
- Omissions are indicated by a caret (^).
- **ns** or **n** may have been used when there was not sufficient evidence to award a grade.
- **CAO** is used when the ‘correct answer only’ is given and the assessment schedule indicates that more evidence was required.
- **CON** may have been used to indicate ‘consistency’ where an answer is obtained using a prior, but incorrect answer and **NC** if the answer is not consistent with wrong working.
- **#** 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’.
- **R** for ‘rounding error’ and **PR** for ‘premature rounding’ resulting in a significant round-off error in the answer (if the question required evidence for rounding).
- **MEI** may have been used to indicate where a minor error has been made and ignored.
- **2ANS** – two answers given.