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SUPERVISOR'S USE ONLY

Level 3 Mathematics and Statistics (Statistics), 2017

91584 Evaluate statistically based reports

9.30 a.m. Monday 27 November 2017
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Evaluate statistically based reports.	Evaluate statistically based reports, with justification.	Evaluate statistically based reports, with statistical insight.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Pull out Resource Booklet 91584R from the centre of this booklet.

Show ALL working.

Make sure that you have the Formulae and Tables Booklet L3–STATF.

If you need more room for any answer, use the space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Excellence

TOTAL

23

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QUESTION ONE

Refer to **Report 1** in the resource booklet to answer the following questions.

- (a) Identify and describe the explanatory and response variables for this study.

Explanatory variable: ~~whether the dogs~~ Whether the dogs were observed in silence or with classical music played into their kennels

Response variable: Stress levels (measured through heart rates, saliva samples, and observation of behaviour)

- (b) The report states that "... dogs' stress levels decreased after listening to classical music".

Explain why each dog's stress levels were measured twice.

Each dog is likely to have different characteristics hence there are sources of variation across all dogs. ~~Therefore~~ This means that dogs will have different stress levels according to variable such as their breeds, age, and others. Therefore, to account for those different characteristics, the effect of listening to classical music should be ~~measured~~ investigated by comparing the stress levels of each dog with and without the intervention (listening to classical music). Therefore, to measure the change in each dog's stress levels, they were measured twice, with and without intervention.

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- (c) The report claims that "Classical music has a calming effect on dogs in rehoming centres".

- (i) In terms of the design of the study (specifically the order of the conditions), what else do you need to know before assessing this claim, and why?

The conditions were switched in the second week, so I would need to know what kind of activities the dogs had to do and whether they were exposed to any specific stressful incidents such as medical surgeries in one week, but not the other. If the dogs were exposed to more stressful circumstances during the week they were in silence, the stress levels would

- (ii) A potential issue with a statistical study is extending the results inappropriately. CONTINUED

Discuss TWO potential issues with extending the results of this study to all dogs in rehoming centres.

1. The investigation was conducted from a specific Scottish SPCA ~~animal~~ animal rescue and rehoming centre. Therefore, there might be the issue of dogs in this particular region behaving differently due to circumstances such as it being rural or urban, compared to other regions in Scotland and furthermore in other countries. This means that before the findings of the results of this study are transferred to all dogs in rehoming centres, it must be ascertained that the dogs in
2. The investigation involved 50 dogs, 21 of which were Staffordshire bull terriers. There are a countless number of dog breeds in the world and it would be expected that each of these breeds exhibit different characteristics and stress manageability inherently. Therefore, before the findings of the results of this study are transferred to all dogs in rehoming centres, it must be ascertained that the breeds of dogs in this rehoming

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QUESTION TWO

Refer to **Report 2** in the resource booklet to answer the following questions.

- (a) The report states that 500 dog owners were surveyed.

- (i) Calculate the margin of error for this survey.

$$\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{500}} = 0.0447 \\ \approx 4.5\% \text{ (2sf)}$$

- (ii) Explain why the margin of error should be included in statistical survey reports.

Margin of error accounts for the variation in the survey percentages arising from sampling (sampling variability).

- (b) Assume that the sample of New Zealand dog owners was representative of all New Zealand dog owners at the time of the survey.

Can a claim be made that over half of New Zealand dog owners have no idea what ingredients are in the food they feed their dog?

Using a relevant survey percentage provided in the report, construct a confidence interval, and interpret this interval as part of your answer.

$MOE = \frac{1}{\sqrt{500}} = 0.0447 \approx 4.5\%$
 (Percentage who reported they have no idea) = 58%
 (Confidence Interval) = 53.5% – 62.5%
 This means that I am fairly confident (95% confidence), that the percentage of NZ dog owners who have no idea what ingredients are in the food they feed the dog to be between 53.5% and 62.5%.
 Since the lower bound of this confidence interval (53.5%) is higher than 50% (half) ~~there~~ the claim could be made that over half of NZ dog owners have no idea what ingredients are in the food they feed their dog.

- (c) The report states that the K9 Natural survey “revealed that 40% of dogs suffer from an array of health conditions”.

- (i) One component to consider when evaluating statistical survey reports is who funded the study.

Explain why there is a potential issue with who funded this survey.

K9 Natural funded this survey, which is a problem because they are a raw dog food company, hence they are in a position where they can directly benefit from the results of this survey. If the survey reveals that ~~that~~ a large proportion of dogs suffer from health conditions, dog owners would be driven to ameliorate this problem by purchasing natural, high-meat diet which K9 Natural sells. Consequently, K9 Natural could have biased the results of this survey with methods such as including continued

- (ii) Discuss ONE potential non-sampling error for this survey and how it could cause bias.

The survey was conducted through an online survey company Survey Monkey. This means that dog owners who do not have access to the online method which Survey Monkey conducts their survey through, are not included in the sampling frame. For example, many older dog owners who would have more knowledge about the food they feed their dogs ~~but not so much about~~ technology, ~~would~~ have been part of the sample, causing bias towards overrepresenting ~~the~~ the percentage that does not know ~~the~~ much about the food. It is hard to say that the people who have access to the online survey is representative of all dog owners, and all dog owners didn't have equal chance of being selected in to the sample ~~because of this~~, which is an error.

QUESTION THREE

Refer to **Report 3** in the resource booklet to answer the following questions.

- (a) The survey states that the margin of error for both the 1992 and 2012 surveys was 3.6%.

- (i) If 1000 New Zealanders had been surveyed, the reported margin of error would be

3.2%.

Was the number of New Zealanders surveyed in 1992 higher or lower than 1000?

Support your answer with statistical reasoning.

Lower than 1000. ~~3.6% is likely to be an average of 1992 and 2012~~

~~3.6%~~ MoE in 1992 (3.6%) is higher than 3.2%. Since higher MoE means lower sample size

- (ii) Explain why it would be inappropriate to use the reported margin of error to construct an approximate 95% confidence interval for the percentage of New Zealanders in 1992 who supported spending on public transport.

The reported margin of error is appropriate to be applied to for survey percentages from 30% to 70%. Since the percentage of NZers in 1992 who supported spending on public transport is 25%, hence lower than 30% it is inappropriate to use the reported MoE. The MoE for this percentage is outside the 30-70 range.

- (b) The report states that for the 2012 survey "those supporting priority spending on public transport had grown to 48 per cent, compared with 37 per cent favouring roads".

Could a claim be made that a higher percentage of New Zealanders in 2012 supported spending on public transport than spending on roads?

Construct ONE confidence interval, and interpret this interval as part of your answer.

$$(\text{Difference}) = 48\% - 37\% = 11\%.$$

$$(\text{MoE of Difference}) = \cancel{1.8 \times 3.6} \quad 2 \times \text{Average MoE} = 1.8 \times 3.6 \quad 2 \times 3.6 = 7.2\%$$

$$(\text{Confidence Interval for Difference}) = 3.8\% - 18.2\% \quad (11\% \pm \text{MoE})$$

This means that I would expect the percentage of NZers in 2012 that supported spending on public transport to be between 3.8% higher and 18.2% higher than the percentage of

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NZers that supported spending on roads in 2012. Since the lower bound of the confidence interval is higher than 0 (3.8%), hence the entire CI is positive, a claim could be made that higher percentage of NZers in 2012 supported spending on public transport than on roads.

- (c) The headline for the report states "Poll shows preference for public transport over motorways and roads has doubled in 20 years".

Evaluate what statistical evidence, if any, has been presented in the report to support this headline.

The poll shows that the proportion of participants who prioritised public transport has risen from 25% in May 1992 to 48% in September 2012, which is almost twice the size ($\frac{48}{25} = 1.92$). However, this does not necessarily mean that the preference for public transport over motorways and roads has doubled. In May 1992, a significant proportion of the participants (32%) answered neither (both/unsure to both options), so it could be that these people have decided to choose public transport, while people who preferred roads and motorways have stayed the same. After all, the percentage who answered neither (both/unsure) fell to 15% in 2012, while percentage who answered roads and motorway stayed similar from 43% (1992) to 37% (2012). There is insufficient evidence to support the headline. The difference in sample also has to be taken into account - different people were surveyed for each poll.

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Extra paper if required.

Write the question number(s) if applicable.

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1(c)(i) be higher when the dogs were observed in silence not necessarily because of the effect of the music, but because of the different situations due to the order of the conditions.

1(c)(ii) This region are representative of all dogs in the ~~dog~~ rehoming centres of the locations that the results are being used for.

2. centre are representative of all dogs in rehoming centres. This might not be the case, as I would not expect 42% ($\frac{21}{50}$) of all dogs in rehoming centres to be Staffordshire bull terriers - I would expect much less proportion, as there are extremely many dog breeds.

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2(c)(i) ~~the~~ ~~the~~ ~~minor~~ ~~and~~ even minor health conditions that do not need much treatment as part of the 40% ~~of~~ of dogs suffer from. This would ultimately result in inappropriate conclusion of the survey that exaggerates the proportion to gain financial profit for the company.

Excellence exemplar 2017

Subject:		Statistics	Standard:	91584	Total score:	23
Q	Grade score	Annotation				
1	E8	<p>1(a) Describes the explanatory and response variables</p> <p>1(b) Demonstrates understanding of paired comparison design</p> <p>1(c)(i) Doesn't discuss order of the conditions being randomly allocated</p> <p>1(c)(ii) Discusses two potential issues with extending the results, both use specific information from the statistical report and both focus on the generalisability of the results (response to classical music in terms of stress and other related behaviours)</p>				
2	E8	<p>2(a)(i) Calculates margin of error using rule of thumb</p> <p>2(a)(ii) Explanation links margin of error and variation of sample/survey percentages</p> <p>2(b) Correctly constructs confidence interval, interprets the confidence interval in context, and uses the confidence interval to support the claim.</p> <p>2(c)(i) Explains why there is a potential issue with who funded the survey but needed to specifically quote evidence from the statistical report</p> <p>2(c)(ii) Describes the non-sampling error (selection bias, reference to sampling frame) as it applies to this context (use of online survey company Survey Monkey) and explains how it could cause bias (possibly excluding older dog owners who know more about the food they feed their dogs)</p>				
3	E7	<p>3(a)(i) Correctly reasons the sample size must be lower since the margin of error is higher.</p> <p>3(a)(ii) Identifies the survey percentage of 25% is outside 30% - 70% guidelines, and explains associated margin of error would be smaller than 3.6%</p> <p>3(b) Identifies sampling situation for margin of error, constructs and interprets the confidence interval in context, and uses the confidence interval to support the claim made. The confidence interval interpretation uses "I would expect" rather than "It's a fairly safe bet", "I'm pretty sure", or "With 95% confidence". The presentation of the confidence interval earlier in the response is also incorrect.</p> <p>3(c) Provides a good explanation that uses a variety of evidence from the statistical report, however, there is no reference to sampling variability in the response despite using survey percentages in the answer.</p>				