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SCHOLARSHIP EXEMPLAR



Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Scholarship 2024 Statistics

Time allowed: Three hours
Total score: 32

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 answer ALL the questions in this booklet.

Pull out Formulae and Tables Booklet S–STATF from the centre of this booklet.

Show ALL working.

Check that this booklet has pages 2–24 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (⚡). This area may be cut off when the booklet is marked.

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

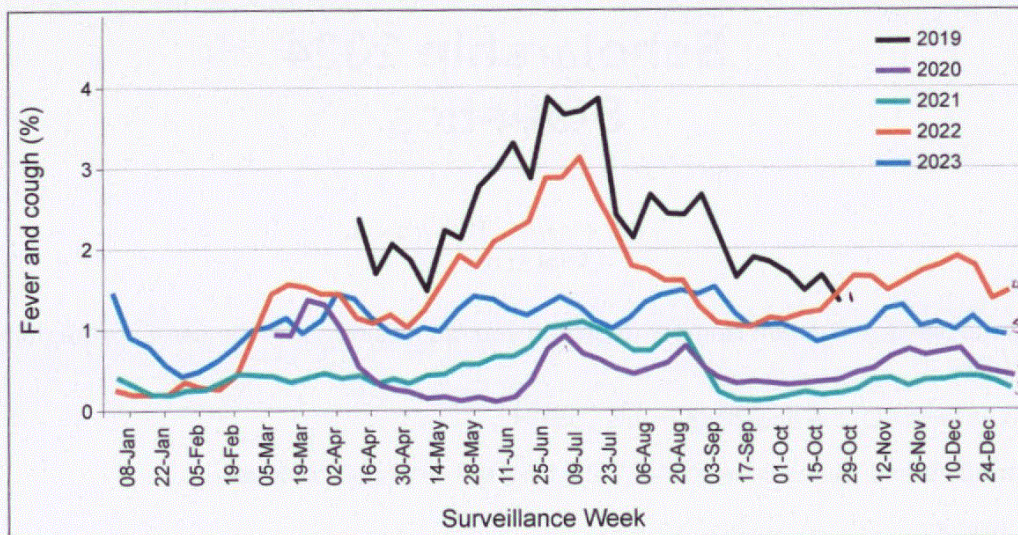
QUESTION ONE

FluTracking is a surveillance system that harnesses both the power of the internet and community spirit for monitoring influenza. Each week, over 110 000 volunteer participants in New Zealand and Australia fill in an online survey about their illness symptoms during the previous week, including whether they have experienced the following:

- fever
- cough
- sore throat
- runny nose
- shortness of breath
- any change in sense of taste or smell
- headache.

- (a) Figure 1 shows the incidence rate of participants in New Zealand who reported having both a fever and a cough during the surveyed week.

Figure 1: FluTracking New Zealand weekly fever and cough symptoms (%) 2023



Adapted from: www.flutracking.net/Info/Report/202353/NZ

- (i) Write one short paragraph describing the key features of the data for the incidence of fever and cough symptoms over the period April 2019 to December 2023.

For the age for the participants of the survey, the most ~~often~~ frequently recorded months that simultaneous fevers and coughs were reported was around June-July, particularly ~~in~~ in 2019 and 2022, which could be due to seasonal ^{people} common viruses had during winter months. The percentage of ~~these~~ ^(trend) ~~sign~~ reporting these symptoms appear to significantly decline from 2019 to the following years of 2020 and 2021, largely increasing

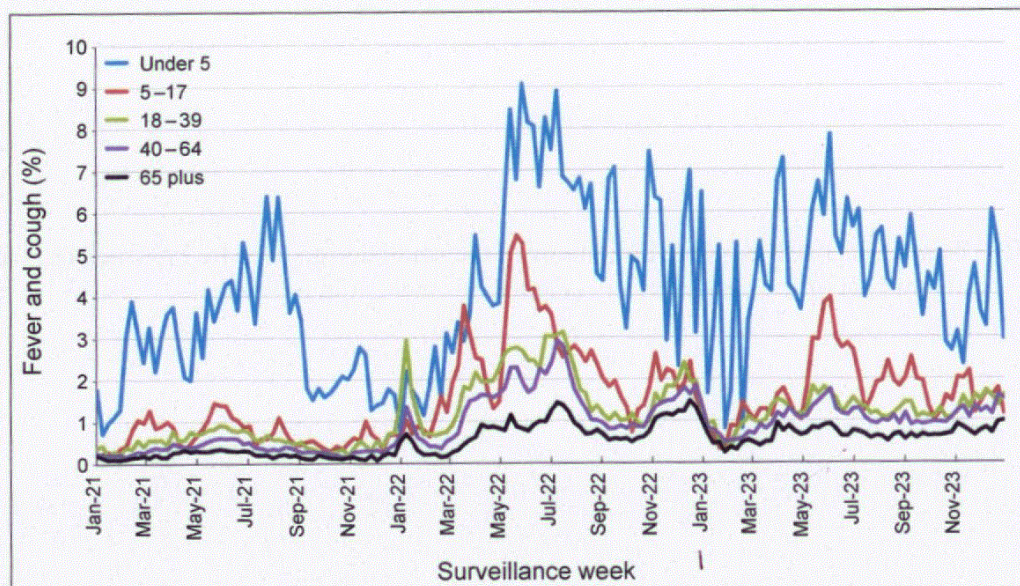
again mid 2022, and appearing to begin to decrease on average overall from 2022 to 2023.

- (ii) Discuss THREE possible limitations of the study design used by FluTracking, including the impact of the design on any conclusions that could be made.

- volunteer based participants: participants may not be representative of the population e.g. ~~not~~ participants need internet access to fill out survey therefore poorer/homeless individuals with higher exposure to illness may not be represented in the study, affecting subsequent conclusions (potentially under-reporting of symptoms)
- as participants need to fill out the survey of their own accord, individuals affected by such symptoms may feel too unwell to fill out the survey ~~as~~ especially ^{if they} ~~clearing~~ are still sick the following week when they are expected to report their symptoms, therefore percentage may not be representative of the ~~whole~~ wider population of New Zealanders
- no detail has been provided regarding the detail of the wording of the questions, so participants interpretation of the ^{required} severity of symptoms being reported may differ, e.g. two people with a very faint cough one week could give different responses to the survey depending on whether they deem the cough significant, which could affect the legitimacy of the results.

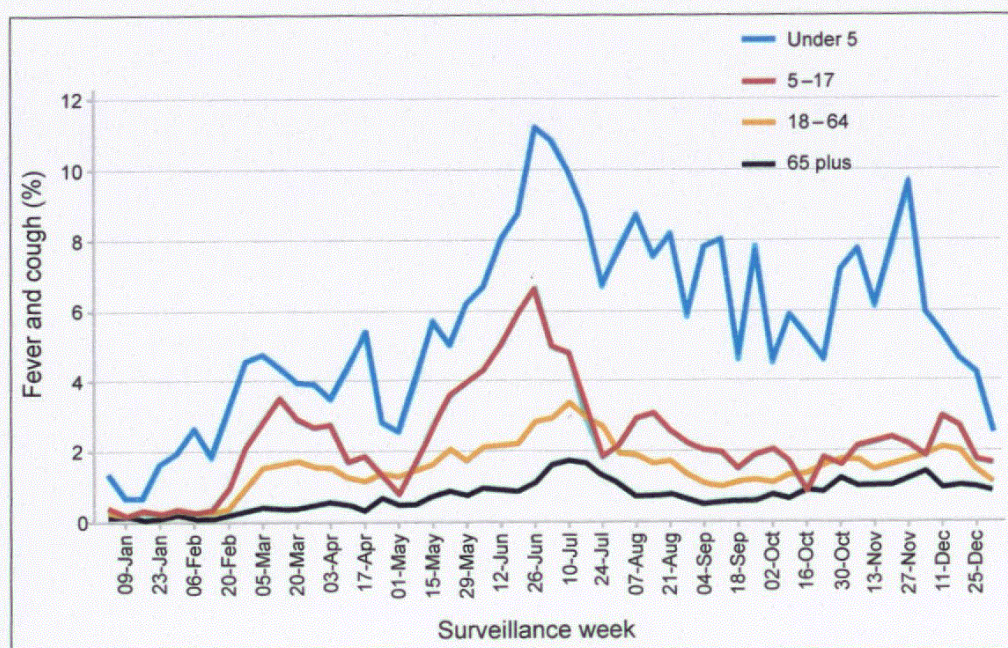
- (b) FluTracking releases weekly reports for both Australia (Figure 2) and New Zealand (Figure 3). These reports include a breakdown of symptoms by age group.

Figure 2: FluTracking Australia weekly fever and cough symptoms (%) by age group 2021–2023



Adapted from: www.flutracking.net/Info/Report/202353/AU

Figure 3: FluTracking New Zealand weekly fever and cough symptoms (%) by age group 2023



Adapted from: www.flutracking.net/Info/Report/202353/NZ

Use Figure 2 and Figure 3 to make THREE statements that compare the incidence of fever and cough in different age groups between the two countries.

- For both Australia and New Zealand, ~~there~~ there is a large variation on the percentage of 'under 5' participants experiencing a fever and cough which appears to inconsistently change week by week, however both countries appear to have seasonal peaks for this age group, particularly around June, ~~reaching~~ reaching ~~at~~ ~11.2% June 2023 in NZ, and ~8% in the same timeframe in Australia.

- In both countries ~~the~~ children under 5 are ~~significantly~~ almost always higher than any other age group in terms of % with cough and fever, meaning these kids tend to be sick more frequently, with the only exception being in January 2022 Australia where this age group % dipped slightly below 18-39 year olds

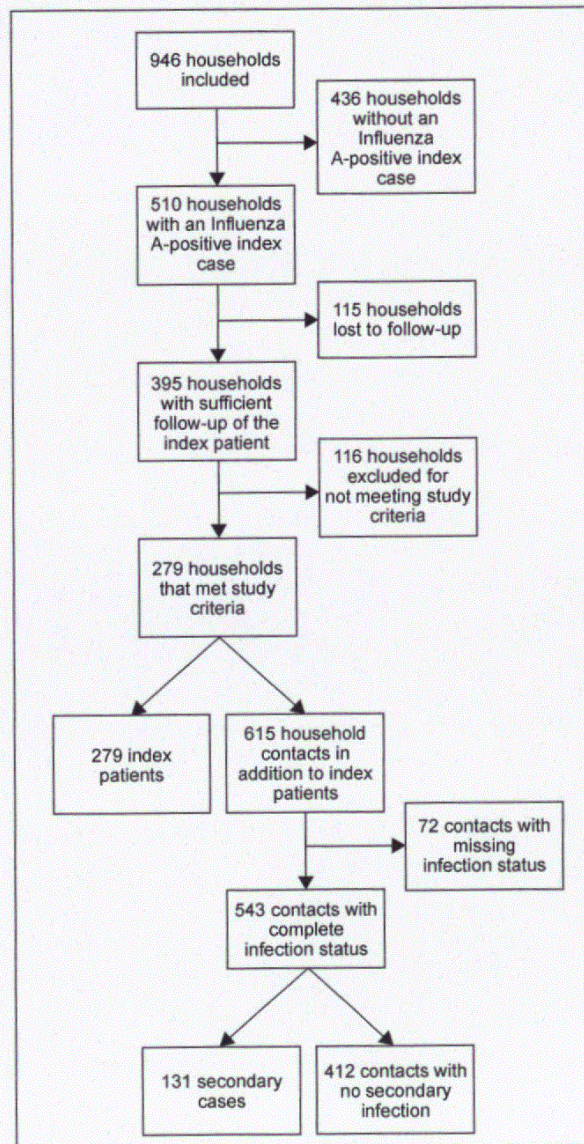
- New Zealand percentages tend to have higher peaks than Australia which can be seen in 2023 data of both countries (no data from 2021-2022 available for NZ). ~~An example of this is~~ An example of this is ~~the peaks of~~ the peaks of ~~the~~ age groups ^{in 2023} (all around June-July) being approximately 11.2%, 6.7%, and 1.8% in NZ for under 5, 5-17, and 65 plus respectively, while Australia's comparative figures are 7.9%, 4%, and 1.95%, all of which are lower than New Zealand. As the age groups of 18-39 and 40-64 are merged in NZ's data it may be difficult to fully compare these, however NZ's peak for this group is around 3.2%, which is higher than both of the split age groups ^{2023 peaks} in Australia further supporting my statement.

- (c) In order to quantify the risk factors of influenza transmission in households, a prospective study was conducted during the 1999/2000 winter season in France.

946 households were enrolled in the study, where one member of the household, the index patient, had visited their doctor because of an influenza-like illness. 510 of the index patients tested positive for Influenza A. Secondary cases of influenza among household contacts of the index patients were identified using a standardised daily questionnaire over a period of 15 days.

Secondary cases were defined as household contacts who had gone on to develop clinical influenza within 5 days of the disease onset in the index patient. 395 households completed the questionnaire, of which 116 were excluded. Figure 4 describes the study design.

Figure 4: Study Design (1999–2000 Winter Influenza Season in France)



Adapted from: Viboud, C. et al (2004), Risk factors of influenza transmission in households, *The British Journal of General Practitioners*, 54(506):684-89

- (i) In the 279 households that met the study criteria, the mean number of children under 15 years of age per household was 0.71.

Calculate an estimate of the number of children under 15 who were recorded as secondary cases in this study.

$$279 \times 0.71 = 198.09$$

$$\frac{131}{543}$$

$$615 \div 198.09 = 3.1046$$

$$\frac{x}{198.09} = \frac{131}{543} \quad \frac{x}{198.09} = \left(\frac{131}{543} \right) \times 198.09 = 47.789$$

$$\approx 48 \text{ children under 15}$$

- (ii) Discuss any issues that may influence the accuracy of your estimate in part (c)(i).

- children under 15 may not have developed immune systems similar to that of older household members therefore could be more likely to ~~get~~ become a secondary case, therefore my estimate may be under-predicted

- larger households with more children may

- ~~as age contacts~~

QUESTION TWO

There are over 200 different viruses that can cause colds. These viruses spread through the air when someone with a cold sneezes or coughs. Once cold symptoms begin, they will usually be resolved within a week.

- (a) A study on the duration of symptoms of the common cold virus was undertaken across Auckland. A researcher conducted an online survey of 620 volunteer participants. Each participant was asked to report the duration of their most recent cold symptoms from onset, also known as day 0. Of the 620 participants in the study, 121 experienced a fever and 612 experienced a sore throat, while 8 participants did not experience either of these symptoms.

Figure 5 shows the density distributions of the duration of fever and sore throat symptoms reported by study participants.

Figure 5: Density distributions of the duration of fever and sore throat symptoms in days

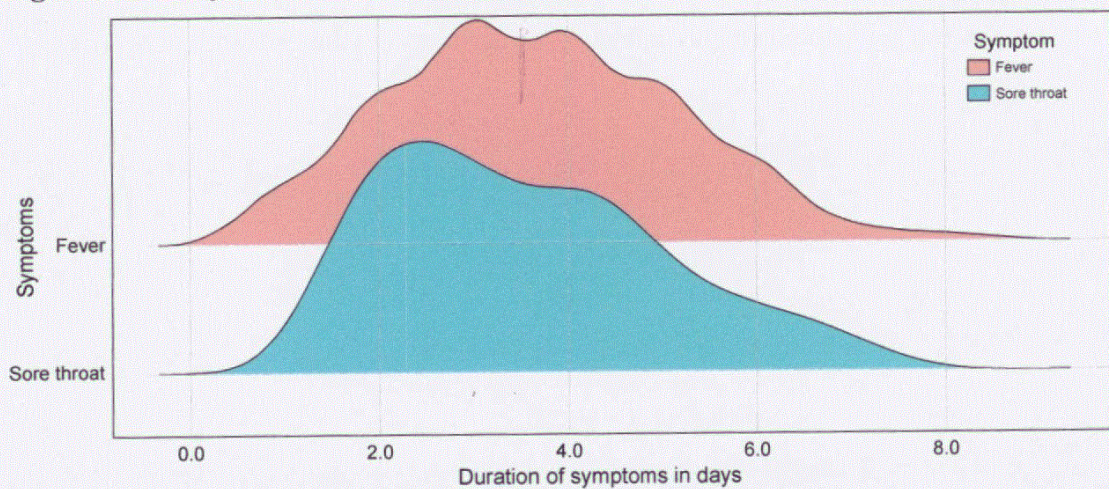
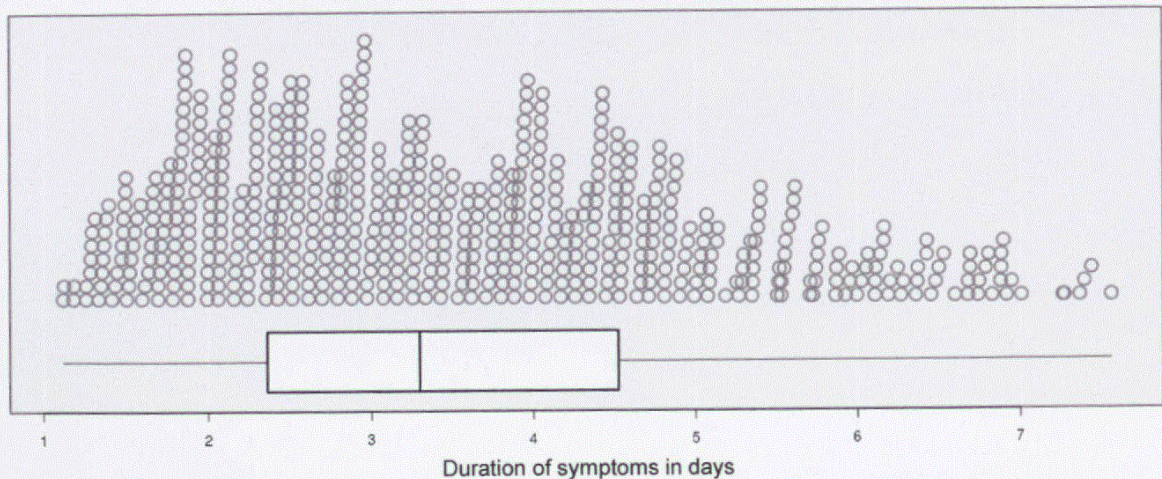


Figure 6 shows the sore throat symptoms, in days, reported by study participants.

Figure 6: Sore throat symptoms in days



Min	25%	Median	75%	Max	Mean	SD	Sample Size
1.12	2.361	3.3	4.521	7.563	3.536	1.471	612

- (i) Suggest a suitable probability distribution model, including relevant parameters, to model the duration of fever symptoms.

Comment on the limitations of the probability distribution model you have chosen.

A normal distribution model would be suitable to model ~~the~~ the duration of fever symptoms for the participants. Appropriate parameters would be a mean of 2.75, ~~minimum of 2.00~~ and a standard distribution of approximately ~~1.33~~ 1.33. A limitation of using this model is that it ~~is not~~ difficult for participants to pinpoint the exact ~~the~~ duration of their symptoms therefore ~~there are~~ ^{durations} ~~are~~ that are multiples of 0.5 days have higher density as that is easier for participants to report, which will not be reflected in predictions made using a normal distribution model due to the continuous nature of the model.

- (ii) It has been suggested that the duration of sore throat symptoms can be modelled by a triangular distribution with the parameters $a:1$, $b:7$, $c:2$.

Using the data and information provided in Figure 6, discuss whether the proposed probability distribution model is appropriate.

Use probability calculations to support your answer.

While a triangular distribution would be suitable for the data, the proposed parameters are not as they would underestimate the durations of symptoms. 'a' should be increased to 1.12, 'b' should be 7.563, while 'c' should be 3.3. With the original proposal for example, the probability of sore throat lasting 3.3 days would be 0.2467, while with my proposal the probability would be closer to the reported figures, 0.3104.

- (b) Minimum sick leave entitlements in New Zealand increased from 5 days per year to 10 days per year from 24 July, 2021. Paid sick leave can be taken by employees when they, or a dependent family member, are unwell. If an employee uses all their available sick leave entitlements, they may take further sick leave as unpaid leave, annual holiday leave, or as sick leave in advance.

The Workplace Wellness Report 2023 surveyed 137 businesses employing 135 742 people across New Zealand. One of the questions in the survey asked for the number of days taken by employees as sick leave in the previous year 2022. Figures showed that in 2022, employees of these businesses took an average of 5.6 whole days sick leave per person. This was an increase of 1.2 days above the average for 2012.

Table 1: Sick leave entitlements and average sick leave taken 2012 and 2022.

	Yearly sick leave entitlement	Average sick leave taken
2012	5 days	4.4 days
2022	10 days	5.6 days

- (i) Using the Poisson distribution model and information provided in Table 1, compare an estimate for the probability that an employee exceeded their yearly sick leave entitlement in 2012, with an estimate for the probability of exceeding their entitlement in 2022.

$$2012: 1 - 0.7199 = 0.2801$$

$$2022: 1 - 0.9718 = 0.0282$$

~~The estimate~~ $0.2801 > 0.0282$, estimate for an employee exceeding their yearly sick leave entitlement in ²⁰¹²~~2022~~ is much higher than in 2022.

- (ii) Discuss TWO potential issues with using the Poisson distribution model with this data.

- A day of sick leave ^{for an employee} may not be independent of each other as ~~some~~ illnesses with higher severity may require multiple consecutive days of sick leave, impacting the suitability of poisson

- Sick days may not be random as external events such as covid affecting a specific time period like 2022 or a specific area could occur, or ~~if~~ one person from a workplace coming in sick could ~~also~~ cause multiple employees to require sick leave.

- (c) A health student from Otago University wanted to investigate whether New Zealanders who were unwell were more likely to take time off from their regular duties, such as work or school, in the winter months compared with the summer months. They conducted two online surveys of randomly sampled New Zealanders in August 2023 (winter) and January 2024 (summer), and asked respondents whether they had experienced an influenza-like illness (a fever with a cough or a sore throat) during the previous month.

The respondents who had experienced an influenza-like illness were then asked an additional question about whether this illness resulted in them being absent from their regular duties. The results of the second question for both surveys is displayed in Table 2 below.

Table 2: Absence from regular duties due to influenza-like illness (ILI)

	Absent from regular duties due to ILI	Not absent from regular duties despite ILI
July 2023	1434	670
December 2023	519	275

Construct a confidence interval and use it to evaluate the claim that New Zealanders with an influenza-like illness are more likely to take time off from their regular duties in the winter months than in the summer months.

proportion of absent due to ILI July: $\frac{1434}{1434+670} = 0.6816$
 proportion December: $\frac{519}{519+275} = 0.6537$

confidence interval: $\frac{\frac{1}{\sqrt{n_1}} + \frac{1}{\sqrt{n_2}}}{2} \times 1.5$

$\frac{1}{\sqrt{1434+670}} = 0.0218$ $\frac{1}{\sqrt{519+275}} = 0.0355$

$\frac{0.0218 + 0.0355}{2} \times 1.5 = 0.043$

$0.6816 - 0.6537 = 0.0279$

As the ~~margin~~ difference between the proportion of NZers absent from regular duties ^{in July} and in December is lower than the ~~margin~~ calculated margin of error ($0.0279 < 0.043$), there is not sufficient evidence within this study to support the claim that NZers with an ILI are more likely to take time off from their regular duties in winter months than in the summer months.

QUESTION THREE

- (a) Asthma is one of the most common illnesses in New Zealand, affecting an estimated 1 in 8 New Zealand adults, and 1 in 7 New Zealand children. There is no cure, but recent advances in medication may improve outcomes for asthma sufferers.

Report 1: Study a 'game-changer' for treating Kiwi asthma sufferers

Asthma affects more than 500 000 Kiwis, but a ground-breaking New Zealand-led study could be about to change the way patients with the respiratory illness are treated.

Currently, most adults with mild asthma are given two different inhaler medications: a preventer and a reliever. The preventer is an inhaled corticosteroid which is taken twice a day. The reliever is an inhaled bronchodilator which is taken whenever needed to relieve asthma symptoms, such as wheezing.

More than 670 people from New Zealand, the United Kingdom, Italy, and Australia with mild asthma took part in the study's trial – 82 per cent were from New Zealand. Participants had been taking only the reliever medication before they started the study. They were randomly allocated into three groups; one third used a reliever inhaler for 12 months whenever they had symptoms. Another third used both a preventer inhaler twice daily and a separate reliever inhaler whenever they had symptoms. The final group used a single combined preventer-reliever inhaler whenever they had symptoms.

The study showed that the risk of an asthma attack was reduced for those who used the single combined preventer-reliever inhaler. The study's results showed the combined preventer-reliever group's risk of an asthma attack was reduced by 60% compared to those who used a reliever alone. The single combined approach was also shown to have a 56% reduction compared to those who used both medications separately.

Adapted from: www.stuff.co.nz/national/health/112844094/study-a-gamechanger-for-treating-kiwi-asthma-sufferers

- (i) Write a short paragraph that identifies the key elements of the study design using appropriate statistical terminology.

~~It~~ It is a ~~individual~~ separate groups study, with ^{two} ~~three~~ different treatments applied to the participants of the study, who were ~~per~~ people from New Zealand, UK, Italy and Australia suffering from mild asthma, and one control group, who were the participants continuing the use of the reliever medication. One treatment group had the treatment of using ~~a~~ a preventer twice daily in addition to the reliever, while the third group used the single preventer-reliever as a replacement to the control ~~group's~~ group's inhaler. the independent

variable was the type of asthma medication used by participants while the dependent variable was the risk of an asthma attack for the patients.

- (ii) Discuss TWO reasons researchers randomly allocated participants into one of the three groups: reliever only, reliever and separate preventer, combined preventer-reliever.

- to ensure that no bias was made in regards to specific treatments being provided ~~to~~ more of a specific age demographic ~~which~~ which could ~~the~~ hinder the fairness of the results

- To ensure that groups ^{still} end up to be of similar sizes, ~~and~~ ~~wasn't~~ ~~enough~~ to allow for fair comparison between the groups, while also limiting bias due to other factors that could influence results of the study such as country, gender, age etc.

- (iii) The study in Report 1 was an open-label trial; there was no blinding, and participants were aware of what medication they were taking. Previous studies were double-blinded and all participants were provided with two inhalers. Participants in the double-blinded studies were randomly allocated into one of three treatment groups:

- active reliever inhaler and placebo preventer inhaler
- active reliever inhaler and separate active preventer inhaler
- active combined preventer-reliever inhaler and placebo preventer inhaler

Discuss why researchers may have chosen not to blind the study in Report 1.

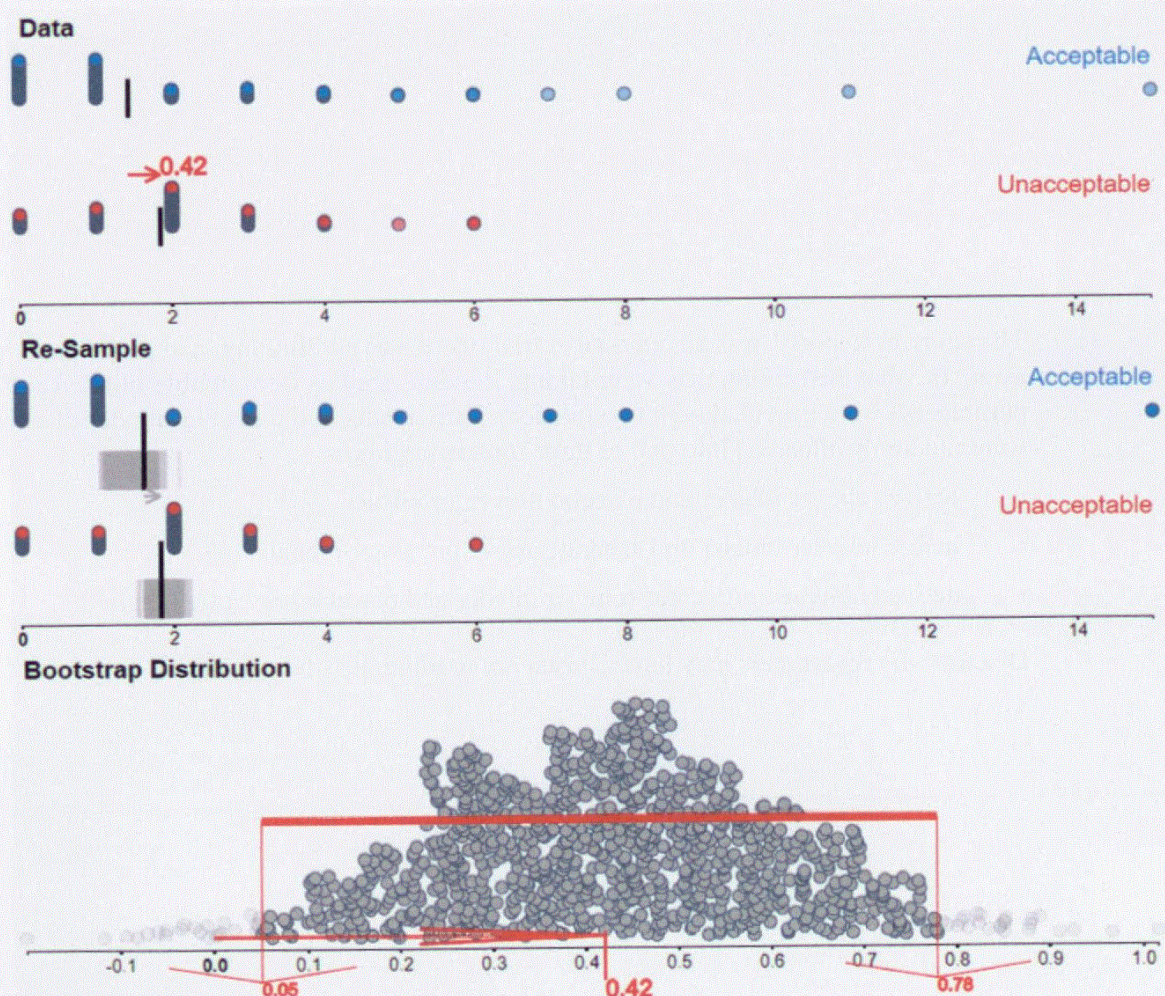
could be coming from ethical reasons, so participants can be aware of exactly what they are putting into their bodies. The open label nature of the trial could also attract more ~~users~~ participants to participate in the study as they ^{can} know what they are consuming, potentially increasing the sample size of the study with a wider range of participants taking part across multiple demographics.

- (b) The New Zealand Healthy Homes insulation standard requires all rental homes to have suitable ceiling and underfloor insulation by 1 July 2025. Adequate insulation results in homes that are warmer, drier, and less prone to mould. The Asthma and Respiratory Foundation of New Zealand recommends that all New Zealand homes be insulated to this standard to help keep those with asthma well, and to minimise their symptoms and potential complications with the illness.

In January 2024, results from a random sample of 2000 rental properties in Otago, Canterbury and the West Coast showed that 12.5% of the occupants in the rental properties surveyed were currently taking medication for asthma. The survey respondents were asked whether they believed their property met the current Healthy Homes insulation standard for both ceiling and underfloor insulation, as well as how many asthma-related healthcare visits each household member made during 2023.

The survey data for household occupants who were currently taking medication for asthma was analysed further. This data was used to construct a bootstrap confidence interval (Figure 7) for the difference between the mean number of healthcare visits by those who live in rental homes with acceptable insulation, and by those with unacceptable insulation.

Figure 7: Bootstrap distribution test output



Discuss what can be concluded from both the features of the sample data distributions and the confidence interval constructed using the sample data, including any reservations you may have about extending any findings from the results.

As seen in the sample data, ~~the~~ ^{household occupants} ~~households~~ living in houses with unacceptable insulation had ~~an average~~ an average of 0.42 more asthma related healthcare visits than occupants of acceptable houses. This sample data is then ~~randomly~~ used to create 1000 resamples to see if the mean difference of 0.42 can be considered statistically significant. As the middle 95% of the ~~data~~ ~~resamples~~ resamples ~~was~~ observed that the mean healthcare visits of unacceptable houses was between 0.05 and 0.78 higher than that of acceptable properties, and this confidence interval does not include 0, ^{therefore} ~~it means~~ there is evidence in this study that can support the ^{conclusion} ~~claim~~ that occupants of households with unacceptable insulation more regularly require healthcare visits as those with acceptable insulation. However, one thing to be cautious of in the use of this data is that it was collected in survey form from occupants of rental properties. This means that some of the survey participants may not fully be aware of the insulation standards of their ~~homes~~ homes, especially as they are renters not ~~the~~ owners. This could ~~be~~ influence the accuracy of the sample data and, consequentially, the results of the bootstrapping.

[* it can be considered statistically significant, therefore]

- (c) In Uganda, large-scale population data on the prevalence of asthma has been lacking. A survey was conducted among 3416 people aged 12 years or older to address this data gap. A questionnaire was used to collect participants' socio-demographics, respiratory symptoms, medical history, and known asthma risk factors.

Participants who reported either a wheeze (difficult, noisy breathing) in the past 12 months, a doctor's diagnosis of asthma, or current use of asthma medications were classified as having asthma. Any one of these three criteria was sufficient for a participant to be recorded as having asthma by the survey organisers.

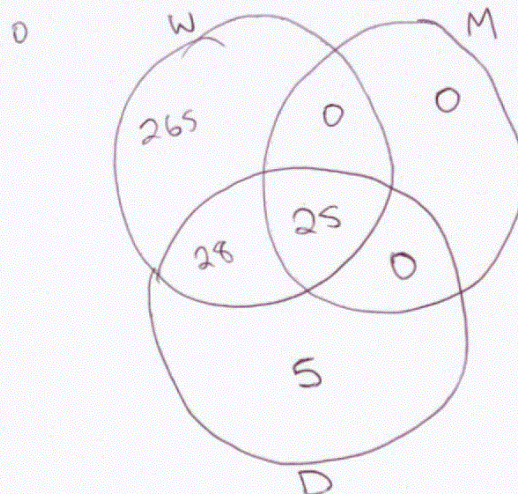
Of all 323 participants recorded as having asthma, 318 reported wheeze in the past 12 months, 58 had a doctor's diagnosis of asthma, and 25 currently used asthma medications. 270 participants had only one of the three criteria, 28 patients had only two criteria, and 25 participants had all three.

Data from: Kirenga, B. (2019), Prevalence and factors associated with asthma among adolescents and adults in Uganda: A general population-based survey. *BMC Public Health* 19(1).

- (i) Calculate the proportion of participants who either reported wheeze in the past 12 months or currently used asthma medications, that had been given a diagnosis of asthma by a doctor before the study.

(assuming inclusion of those with both wheeze + medication)

$$\frac{28+25}{265+28+25} = \frac{1}{6} = 0.1667$$



- Discuss any reservations or considerations you have about using this method.

QUESTION FOUR

- (a) For patients in the United Kingdom who are hospitalised with influenza, asthma is one of the most common pre-existing medical conditions. Data was collected from patients admitted to 75 hospitals in 31 United Kingdom cities or towns with a confirmed influenza infection. Some of the differences between the patients are listed in Table 3.

Table 3: Treatments and clinical outcomes for asthmatics and non-asthmatics hospitalised with influenza infection

	Asthmatics	Non-asthmatics
Total patients	385	1135
Pre-admission treatments:		
Antibiotics	78	202
Antivirals	44	128
Inhaled corticosteroids	203	51
Clinical outcomes:		
Pneumonia	66	188
Severe outcomes (e.g. admission to intensive care)	43	225

Data from: Myles, P. et al (2013). Differences between asthmatics and non-asthmatics hospitalised with influenza A infection. *European Respiratory Journal*, 41: 824-831

- (i) Compare the rates of both 'Pneumonia' and 'Severe outcomes (e.g. admission to intensive care)' for asthmatics and non-asthmatics.

asthmatics ~~11~~ → pneumonia: $\frac{66}{385} = 0.1714$

↳ severe outcomes: $\frac{43}{385} = 0.1117$

non-asthmatics: ~~1135~~ → pneumonia: $\frac{188}{1135} = 0.1656$

↳ severe outcomes: $\frac{225}{1135} = 0.1982$

Asthmatics have a higher rate of pneumonia than severe outcomes, and also have a higher rate of pneumonia than non-asthmatics. Non asthmatics have higher rates of severe outcomes than pneumonia, and also have higher rates of severe outcomes than ~~non~~ asthmatics.

- (ii) Based on the data in Table 3, describe which pre-admission treatment might best explain the observed differences in rates of severe outcomes for the two groups.

Inhaled corticosteroids might best explain the ^{observed} differences between the rates of severe outcomes for the two groups as it is the pre-admission treatment with the most extreme difference ~~between~~ ^{of} the proportion of patients who took it between the two groups. ~~in~~ 203 of 385 (roughly 52.3%) of asthmatics previously used corticosteroids while only 51 out of ~~1135~~ 1135 (roughly 0.45%) of non-asthmatics used this treatment ~~therefore~~ which could explain the much higher proportion of patients with severe outcomes for non-asthmatics (0.1982) compared to that ~~of~~ of asthmatics (0.1117).

- (iii) 19% of all patients in the study had short hospital stays (less than two days duration), of which 71 individuals were asthmatics.

Compare the proportions of short hospital stays for asthmatics compared to non-asthmatics.

$$385 + 1135 = 1520 \quad 1520 \times 0.19 = 288.8 \approx 289 \text{ patients}$$

$$\frac{71}{385} = 0.1844 \quad \frac{289}{1135} = 0.2546$$

The proportion of asthmatics that had short hospital stays is 0.1844, ~~lower~~ which is a lower rate than the proportion of non-asthmatics who had shorter stays which is 0.2546.

Question Four continues
on the following page.

- (iv) For the 385 asthmatic patients in this study, the probability that two randomly chosen, consecutive patients are children is 0.0356.

Use this information to determine how many children were in this study.

~~$$\frac{x}{385} \times \frac{x-1}{384} = 0.0356$$~~

~~$$\frac{x(x-1)}{147840} = 0.0356$$~~

$$x^2 - x = 5263.104$$

~~$$x^2 - x - 5263.104 = 0$$~~

~~$$x = 73.05 \text{ or } x = -72.05$$~~

73 (can't have fraction of a child)

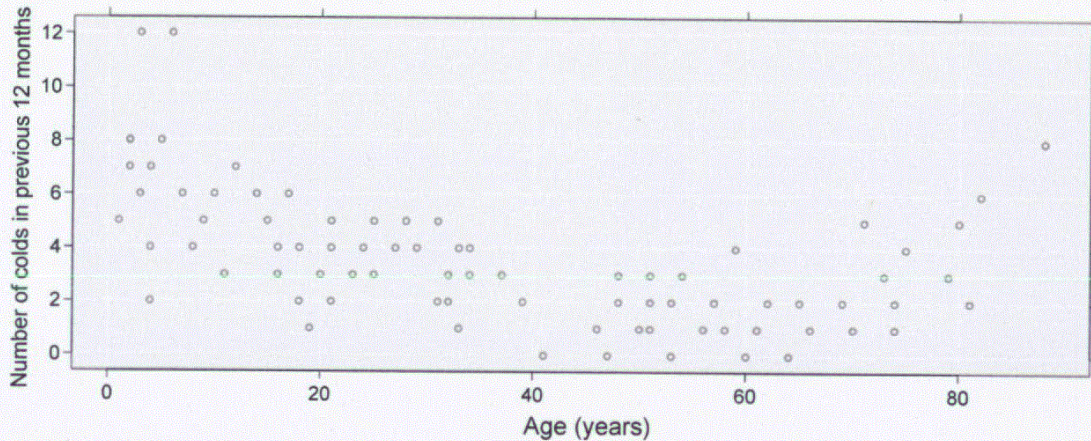
number of children cannot be negative

therefore there are ~~approximately~~ 73 children in the study.

- (b) The New Zealand Ministry of Health claims that as people age, they tend to get fewer colds due to a build up of immunity to some cold viruses. To test this theory, researchers took a random sample of 80 patients from four GP practices in Auckland. These patients were asked to recall the number of colds they had experienced in the previous 12 months. When a patient was under the age of 14, their caregiver was asked to recall the number of colds the patient had experienced in the previous 12 months.

Figure 8 shows a scatterplot displaying each person's age in years plotted against the number of colds each person experienced in the previous 12 months

Figure 8: Number of colds in previous 12 months versus age in years



Identify key features of the data shown in Figure 8, and use these to discuss the relationship between age in years and the number of colds experienced in the previous 12 months.

Until the age of 40

For patients under 40, there appears to be a negative association with a decreasing trend and a moderately weak relationship, meaning as the age of a person increases the number of colds tends to decrease. For ages 40+, there appears to be an increasing trend with a positive association between age and number of colds in previous twelve months and a moderately weak relationship, meaning number of colds tends to increase as age increases for people in this age range.

Scholarship

Subject: Statistics

Standard: 93201

Total score: 20

Q	Score	Marker commentary
1	5	This question provides evidence for 5s because the candidate has gained at least 5s grades overall. The candidate has not provided numerical evidence when discussing trends or key features of time series data in context from Figure 1. They have at least two sufficient statements describing non-sampling errors in context. They have at least 3 sufficient comparison statements, with evidence, comparing relevant trends or features of time series data from two graphs from Figures 2 and 3. They have not calculated a valid estimate for the proportion of children who were recorded as secondary cases in the study in Figure 4, however they have discussed one issue that may have influenced the accuracy of an estimate made from Figure 4.
2	5	This question provides evidence for 5s because the candidate has gained at least 5s grades overall. The candidate has identified a suitable probability distribution model but has not identified suitable parameters. They have identified at least one limitation of this model. The candidate has not calculated a suitable probability for evaluating the goodness-of-fit of a probability distribution model. They have correctly calculated probabilities from a Poisson distribution model but have not compared these proportionally. They have evaluated the Poisson model for the given situation and have discussed two appropriate limitations. They have calculated and appropriate estimate for the margin of error for a given situation but have not interpreted the confidence interval appropriately.
3	6	This question provides evidence for 5s because the candidate has gained at least 6s grades overall. The candidate described three key features of an experiment in context using statistical language. They discussed at least two reasons for random allocation in context. They did not identify a suitable purpose for an open label trial. They have not appropriate language when comparing centrality from sample data from a bootstrap distribution and they have omitted the population in their confidence interval

		interpretation, however they have adequately discussed one potential issue with the sampling strategy for this study. They have correctly calculated a conditional probability.
4	4	This question provides evidence for 4s because the candidate has gained at least 4s grades overall. The candidate has correctly compared appropriate rates but has not used a relative approach. They have reasoned with evidence that the use of corticosteroids is associated with the observed difference in severe outcomes for asthmatic patients, and again have not used a relative approach. They have not calculated appropriate proportions for short hospital stays for asthmatics compared to non-asthmatics. The candidate has calculated the number of children in a study and has considered non-replacement. They have identified the nature of the data in Figure 8 but have not identified the strength or the effect of outliers or unusual groupings.