NCEA Level 3 · AS 91582: Making the Call with Confidence Intervals

Name: _____ Date: _____

Hi! This standard is about using a bootstrap confidence interval to make a formal inference comparing two groups back in their populations. Work through each section in order, and always finish by writing your 'call' in context.

Revision summary

- Formal inference = making a claim about a POPULATION difference using a SAMPLE.
- Bootstrap: resample each sample WITH replacement (same size), record the difference in statistics (e.g. median A − median B), repeat ~1000 times to build a bootstrap distribution.
- Confidence interval (CI): the middle 90% of the bootstrap distribution, from the 5th percentile to the 95th percentile of the resampled differences.
- Making the call: if the whole CI is above 0, infer group A's population parameter is larger; if entirely below 0, it is smaller; if the CI contains 0, you cannot make a call (the difference could plausibly be zero).
- Interpretation: 'It is a fairly safe bet that the median [variable] for [population A] is between X and Y greater/less than for [population B].'
- Sampling variability: different samples give different statistics; larger samples give narrower CIs and more reliable calls.
- Always compare like with like, use the sample size, spread, shape and any outliers to support or temper your inference.
- Good justification links the CI position relative to 0, the sample sizes, and the practical context.

Key skills

1. A bootstrap confidence interval for the difference in median weekly grocery spend (Avondale households − Blockhouse Bay households) is (−$5, $42). Does this interval let you make a call about which population has the higher median spend? Briefly say why.

2. Explain what 'resampling with replacement' means when bootstrapping from a sample of 30 commute times.

3. A bootstrap distribution of 1000 differences in mean rainfall (mm) is sorted. The 50th value is 2.1 and the 950th value is 18.4. Write down the 90% bootstrap confidence interval.

4. A CI for the difference in median screen time (Year 13 students − Year 9 students) is (0.4 h, 2.7 h). Write the formal call in context.

Achieved

5. A researcher samples 40 kūmara from a Dargaville farm and 40 from a Kaipara farm, recording weight (g). A bootstrap gives a 90% confidence interval for the difference in median weight (Dargaville − Kaipara) of (12 g, 58 g). Make a formal inference in context.

6. From samples of daily bus wait times (minutes) in Onehunga and Ōtāhuhu, a bootstrap CI for the difference in medians (Onehunga − Ōtāhuhu) is (−9.2, −1.5). What can you conclude?

7. Explain why we make an inference about the POPULATION and not just report which SAMPLE median is higher.

8. A CI for the difference in mean weekly earnings (part-time workers aged 18–20 − aged 21–24) in a survey is (−$85, −$10). Give the call and state one reason a wider sample might change your confidence.

Merit

9. Two samples of marathon finish times (minutes) are taken: Auckland runners (n = 60, sample median 248, IQR 42) and Wellington runners (n = 55, sample median 261, IQR 39). A bootstrap 90% CI for the difference in medians (Auckland − Wellington) is (−24, −2). Discuss what this tells you, linking the sample summaries to the inference.

10. A student takes two samples from the same population by mistake and bootstraps a CI for the difference in medians, getting (−3.1, 3.4). They conclude 'there is no difference in the populations.' Explain why this wording is not quite right and give a better statement.

11. Explain, with reference to how the bootstrap distribution is built, why increasing each sample size from 20 to 80 tends to give a narrower confidence interval.

Excellence

12. A council claims 'water use per household is the same in Titirangi and Glen Eden.' Samples give a 90% bootstrap CI for the difference in median daily water use (Titirangi − Glen Eden) of (18 L, 61 L). A councillor argues this 'proves' the council is wrong. Critique both the council's claim and the councillor's argument, and state what can properly be concluded.

13. Two analysts study the same two populations. Analyst A uses samples of size 25 and gets CI (−2, 30) for the difference in medians; Analyst B uses samples of size 200 and gets CI (6, 22). Explain how both results can be consistent, and discuss which supports a stronger inference and why.

14. Explain why a bootstrap confidence interval built by resampling can be trusted to reflect population uncertainty, even though we only ever resample from a single original sample and never from the population itself.