

NMSSA Approach to Sample Weighting

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1. Introduction

NMSSA reports on achievement levels in different learning areas for Year 4 and Year 8 student populations in New Zealand. The NMSSA sample is drawn so that students in New Zealand have an approximately equal chance of being selected into the sample. To achieve this, NMSSA randomly samples students within randomly-sampled, state and state-integrated schools, using school stratification variables: region, decile and school size.

NMSSA also reports achievement levels for some key subgroups that are not directly accounted for in the initial sample stratification (for instance, gender and ethnicity). These key subgroups may not be properly nationally represented in the achieved sample as they were not included in the original school stratification. Applying post-stratification weights can correct for misrepresentation of subgroups.

Each year NMSSA selects a new sample to assess achievement in up to two learning areas.

This paper describes the general method NMSSA uses to calculate sample weights. Up to the present time, annual investigations into the necessity for incorporating sample weights have resulted in a recommendation that weights are an unneeded addition to analysis.

While NMSSA continues to sample schools and students using the standard NMSSA sample procedure¹, it is unlikely that sample weights will prove necessary to analysis. However, each year the new achievement data is checked for representativeness overall and in key subgroups, and comparisons between using weighted and unweighted data are briefly summarised in the annual technical report.

If, at any time in the future, the use of weights is deemed necessary, the affected technical documents will be updated.

How to assess the need for weights

Where sample weights are seen to make no significant difference to the reported results in any of the key reporting groups or subgroups, NMSSA will report findings without reference to sample weights.

Multiple ethnicities

NMSSA data is reported allowing for students to belong to multiple ethnic groups. In applying sample weights this must be taken into consideration. Tables of numbers of students by gender and by non-prioritised ethnicity for each school are specially provided to NMSSA by the Ministry of Education (MoE) each year. The publically available July school roll returns contain all other information needed to calculate national probabilities of group (and subgroup) membership.

2. Method

The NMSSA sample has two mutually exclusive parts: a Year 4 sample, and a Year 8 sample. The samples are selected to be representative at a national level in each of these year groups. For details of the sampling methodology Appendix 1, *Sample Characteristics for 2017*. The initial sample stratification variables are region, school decile and roll size in the year group of interest. Students are selected randomly from within each selected school.

Post-strata

The achieved NMSSA student sample is post-stratified as follows:

- Quintile (quintiles 1 - 5)
- Gender (female/male)
- Ethnic group(s)
 - NZE/non-NZE
 - Māori/non-Māori
 - Pacific/non-Pacific
 - Asian/non-Asian

¹ Appendix 1: *Sample Characteristics for 2017*.

Each ethnic group is treated separately to allow for students belonging to multiple ethnic groups. Each sample member is initially assigned four separate sample weights, one for each ethnic group.

For **each** ethnic group a sample member belongs to one of 20 possible strata. See Table A3.1.

Table A3.1 Post-strata (20 cells) for one ethnic group

Qunitile	1				2				3				4				5			
Gender	Female		Male		Female		Male		Female		Male		Female		Male		Female		Male	
Ethnic group indicator	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

Calculating weights

For each ethnic group weights are calculated as follows:

$$\text{Weight} = \frac{\text{Stratum probability}_{\text{national}}}{\text{Stratum probability}_{\text{sample}}}$$

A **final weight** taking an average over all four weights is then calculated. This final weight is suitable to be used for reporting purposes if recommended.

3. Do the sample weights change the results? An example

What follows is an example of the 2017 results for science achievement. The tables and graphics shown in this section are part of the standard annual weighting investigation procedure.

Figure A3.1 and Figure A3.2 show the overall distributions of science achievement at both Year 4 and at Year 8. They show there is very little difference with respect to unweighted or weighted data.

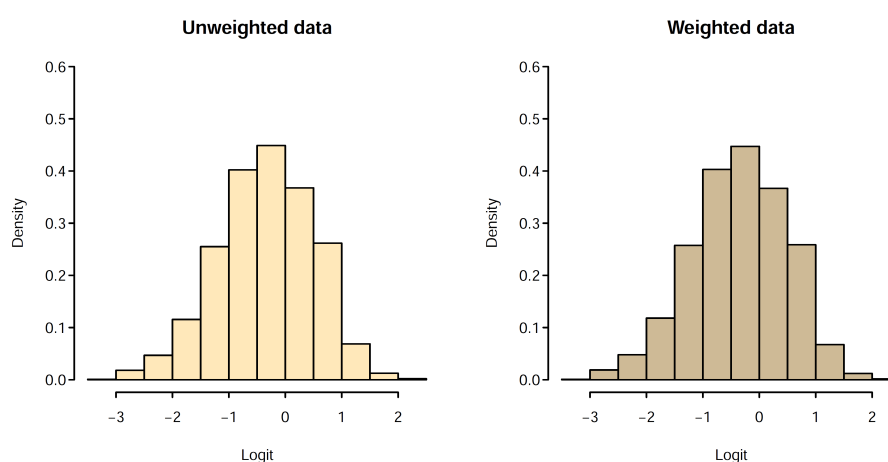


Figure A3.1 Year 4 science achievement

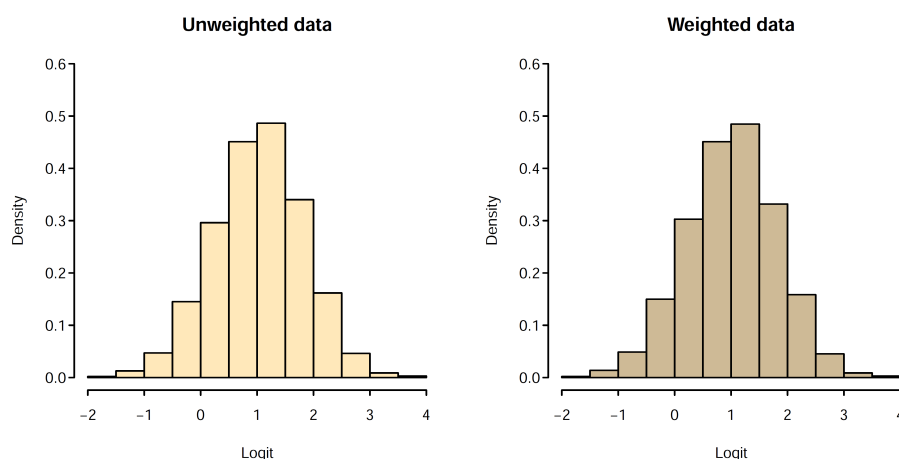


Figure A3.2 Year 8 science achievement

In Table A3.2 and Table A3.3 very slight differences can be seen across all sub-groups in the mean and standard deviation estimates. However, since all weighted estimates are well within a standard error of the unweighted estimate, weights are not deemed to be necessary to further analysis.

Table A3.2 Comparison of Year 4 results for NMSSA science achievement: Weighted and unweighted data

	Mean ² (unweighted)	sd (unweighted)	Mean (weighted)	sd (weighted)	Difference	N
All	82.7	0.6	82.2	0.6	-0.5	2094
Girls	84.5	0.8	84.3	0.8	-0.2	1039
Boys	80.4	0.8	80.3	0.8	-0.1	1055
NZE	87.5	0.6	87.4	0.6	-0.1	1238
NZE girls	89.3	0.9	89.2	0.9	-0.1	615
NZE boys	85.8	0.9	85.7	0.9	-0.1	623
Māori	72.9	1.1	72.7	1.1	-0.2	484
Māori girls	76.3	1.4	76.2	1.4	-0.1	234
Māori boys	69.7	1.6	69.6	1.6	-0.1	250
Pacific	66.3	1.6	66.1	1.6	-0.2	254
Pacific girls	69.0	2.1	68.9	2.1	-0.1	136
Pacific boys	63.1	2.4	62.9	2.4	-0.2	118
Asian	88.6	1.4	88.6	1.4	0.0	287
Asian girls	89.8	1.9	89.6	1.9	-0.2	152
Asian boys	87.4	2.0	87.4	2.0	0.0	135
Quintile 1	64.0	1.3	63.9	1.3	-0.1	334
Quintile 2	78.1	1.3	78.1	1.3	0.0	365
Quintile 3	81.7	1.3	81.7	1.3	0.0	341
Quintile 4	87.6	1.1	87.6	1.1	0.0	420
Quintile 5	91.7	0.9	91.7	0.9	0.0	634

² All measures relating to the NMSSA science scale are recorded in NMSSA scale score units in all tables.

Table A3.3 Comparison of Year 8 results for NMSSA science achievement: Weighted and unweighted data

	Mean (unweighted)	sd (unweighted)	Mean (weighted)	sd (weighted)	Difference	N
All	116.7	0.5	116.3	0.5	-0.4	2040
Girls	118.6	0.7	118.2	0.7	-0.4	1034
Boys	114.8	0.8	114.5	0.8	-0.3	1006
NZE	121.0	0.6	120.9	0.6	-0.1	1285
NZE girls	122.6	0.8	122.5	0.8	-0.1	667
NZE boys	119.3	0.9	119.2	0.9	-0.1	618
Māori	107.0	1.0	106.7	1.0	-0.3	473
Māori girls	109.7	1.4	109.5	1.4	-0.2	241
Māori boys	104.2	1.4	104.0	1.4	-0.2	232
Pacific	103.7	1.4	103.5	1.4	-0.2	224
Pacific girls	106.2	2.0	105.8	2.0	-0.4	105
Pacific boys	101.6	2.0	101.6	2.0	0.0	119
Asian	122.1	1.7	121.7	1.7	-0.4	205
Asian girls	123.5	2.4	123.1	2.4	-0.4	97
Asian boys	120.7	2.3	120.5	2.3	-0.2	108
Quintile 1	102.0	1.3	101.9	1.3	-0.1	267
Quintile 2	110.2	1.2	110.1	1.2	-0.1	353
Quintile 3	116.1	1.1	116.0	1.1	-0.1	407
Quintile 4	121.5	1.0	121.4	1.0	-0.1	494
Quintile 5	124.7	0.9	124.7	0.9	0.0	519

Summary graphics

Other standard summary graphics help to arrive at a sensible conclusion.

Figure A3.3 graphs the differences between unweighted and weighted estimates. The magnitude of the differences compared to the 95 percent confidence intervals is very clear. Note that the dotted lines are included as a visual aid only.

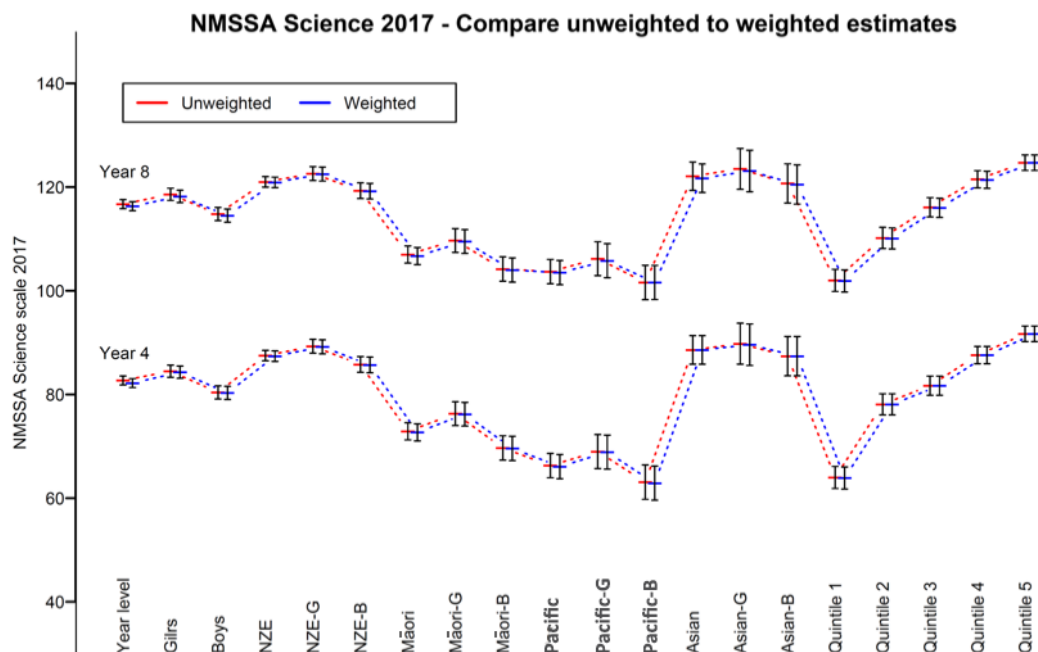


Figure A3.3 Comparison of unweighted to weighted estimates

Figures A3.4 to A3.9 provide more standard comparative plots showing distributions of achievement scales in various key subgroups.

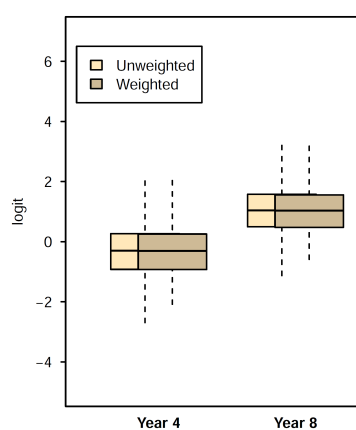


Figure A3.4 Comparison of weighted and unweighted science scores, by year level

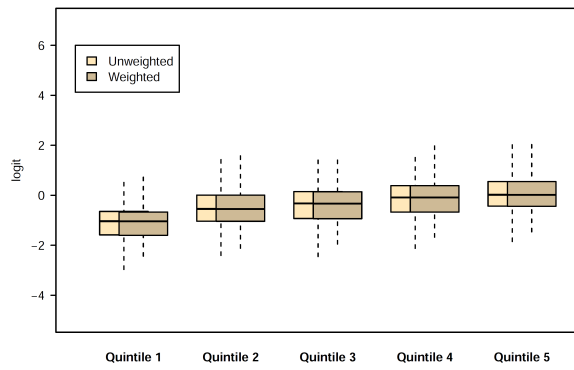


Figure A3.5 Comparison of Year 4 science scores, by quintile

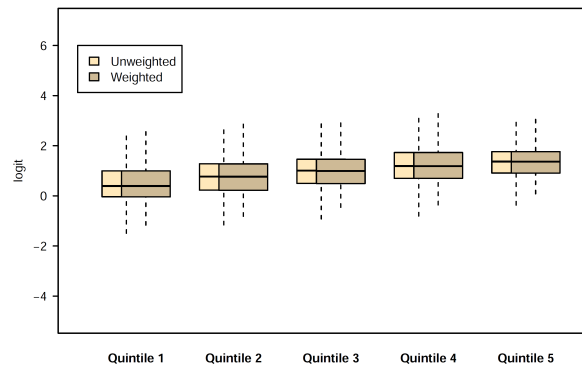


Figure A3.6 Comparison of Year 8 science scores, by quintile

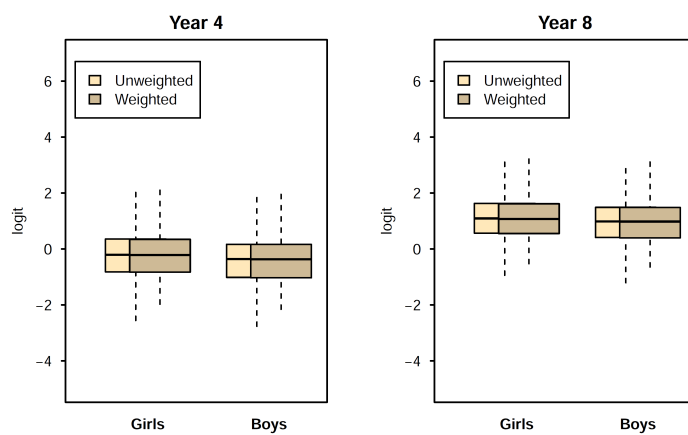


Figure A3.7 Comparison of science scores by gender

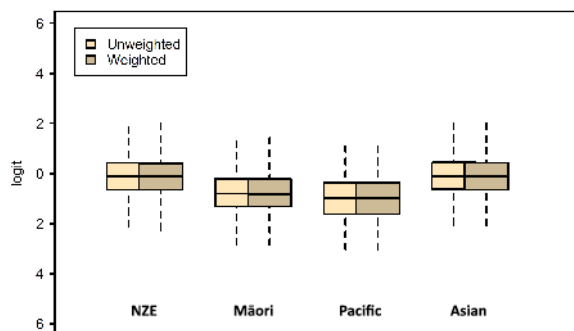


Figure A3.8 Comparisons of Year 4 science scores, by ethnicity

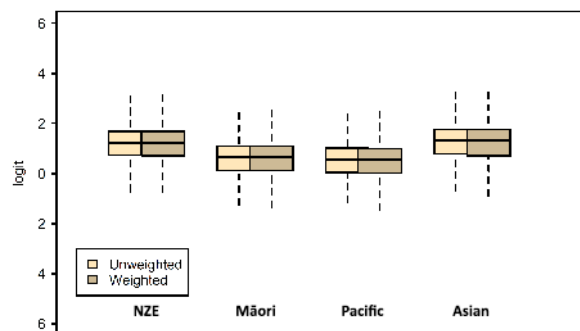


Figure A3.9 Comparisons of Year 8 science scores, by ethnicity