PAT Science

Australian norms 2023 update

Australian Council *for* Educational Research

Contents

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Figures and tables

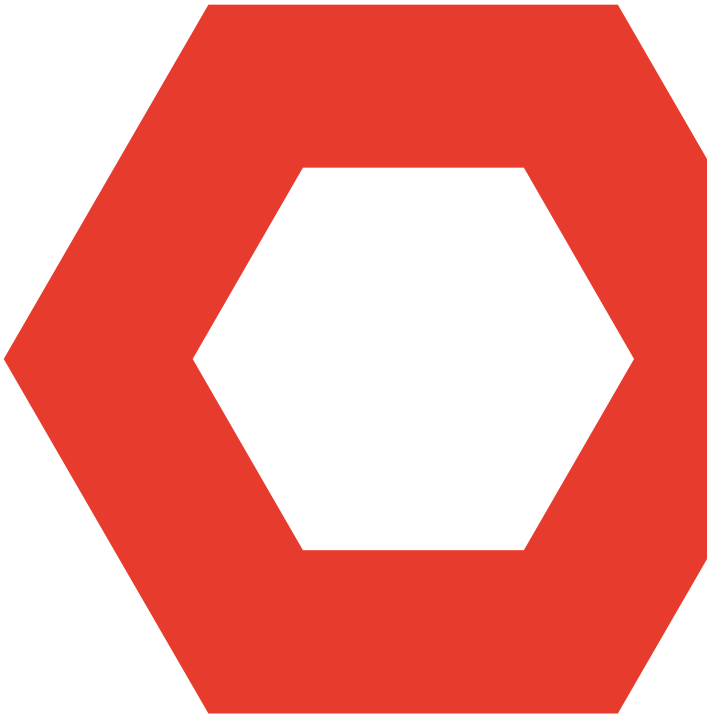
Introduction

Australian norms are provided as a point of comparison between students' estimated achievement on the PAT Science scale and the typical achievement of students at each year level nationally. Comparisons between a student's scale score achievement and the Australian norm for a given year level can be expressed as a percentile rank. The percentile rank of a student's scale score indicates the proportion of the comparison group who achieved lower than that scale score. Conversion tables outlining the corresponding raw scores, scale scores, and percentile ranks can be found on page 10.

Norm comparisons provide contextual information about a student's relative achievement, but they do not indicate the skills or knowledge that can be expected of the student according to their achievement on their PAT Science test, nor can they be used to infer progress over time. The student's estimated scale score and the described achievement bands are the best measures for these purposes.

A note on terminology

This document refers to the current norms as the '2023 update', reflecting the year of their publication. The data that comprise the norms were collected in 2019 and represent student achievement at that time.



Australian norms

PAT Science norms are established using a de-identified sample of Australian students at each year level. This is the first norm update since 2008. The 2023 norm update sample is drawn from PAT Science 1st Edition tests completed in ACER's Online Assessment and Reporting System (OARS) during October and November 2019.

The sample is limited to students tested around the same time of year so that comparisons can be made to students at approximately the same stage of their schooling. Students in a particular year level completing a test at the beginning of the year would likely perform differently from students at the same level tested at the end of the year.

At each level, year 3–10, only cases where the student's age fell within an appropriate range were retained. The age ranges were drawn from Australian Bureau of Statistics (ABS) data on the distribution of students by age and year level. This measure was taken to minimise erroneous or unusual year - level information in the OARS database and with the assumption that students described as being in a particular year level at the time of testing would fall within the typical age range.

The sample was further restricted to schools that could be matched to the ACER 2019 School Sampling Frame, which provides population-level information about schools and students in Australia.

2023 norm sample

The final numbers of schools and students comprising the 2023 norm sample are shown in Table 1. The total number of students' results used to calculate the norms are presented by state/territory in Table 2 (page 3) and by sector in Table 3 (page 3).

Table 1 *Schools and students by year level*

Year level	Number of schools	Number of students
Year 3	399	15 991
Year 4	413	17 217
Year 5	405	16 764
Year 6	436	18 384
Year 7	162	10 715
Year 8	130	9105
Year 9	119	8201
Year 10	90	4917

Table 2 *Students by year level and state/territory*

Year level	ACT	NSW	NT	Qld	SA	Tas	Vic	WA
Year 3	89	3002	197	1381	762	184	4459	5917
Year 4	117	3232	195	1391	881	166	4710	6525
Year 5	66	3051	185	1488	924	159	4594	6297
Year 6	144	3431	196	1391	1012	163	4748	7299
Year 7	283	3560	175	421	1029	215	3723	1309
Year 8	263	2338	140	325	899	221	3863	1056
Year 9	424	2299	160	332	837	194	3247	708
Year 10	397	1148	0	159	684	149	1717	663

Table 3 *Students by year level and school sector*

Year level	Government	Catholic	Independent
Year 3	11 637	2796	1558
Year 4	12 379	3171	1667
Year 5	12 053	2946	1765
Year 6	12 978	3214	2192
Year 7	4446	4023	2246
Year 8	4003	3327	1775
Year 9	3327	3084	1790
Year 10	2289	1464	1164

The data for this study are 'self-selecting'. This means that the sample was not selected using probability sampling methods but rather used all appropriate data gathered from PAT Science tests in OARS in 2019. Therefore, the data are not necessarily nationally representative. This represents a change in methodology since the estimation of the 2008 PAT Science norms.

Because the data for this norm study are self-selecting, a weighting adjustment is applied for analysis so that students representing different components of the national population – for example, states, sectors, locations, and socio-economic backgrounds – contribute to the norm outcomes in proportion to their representation in the population.

Weighting

The underlying assumption behind weighting is that the participating student is representative of the group of students that the student is being weighted to – the so-called 'weighting class'. This assumption is more likely to hold when the weighting class is confined to a relatively small part of the population. Rather than simply considering year 3 students in the OARS database from Victoria as representative of all Victorian year 3 students and giving each participant the same weight reflecting the proportion of that group in the data, it is better to consider those students as representatives of smaller subgroups within the more extensive Victorian year 3 group – for example, students from schools in similar locations or socio-economic areas, or students from the same school sector.

At the same time, it is important that a good number of schools and students represent weighting classes. Too few participating schools or students representing a weighting class may lead to individual students being assigned relatively large weights. This is undesirable as these students may have an overly strong influence on outcomes.

Therefore, the formation of weighting classes is an exercise in finding well-defined, smaller subgroups within the population within which a good number of schools and students have participated. For each year level, the available student data was distributed across subpopulations defined by the following criteria:

Jurisdiction	Six states
	Two territories
Management	Government
	Non-government
Sector	Government
	Catholic
	Independent
School location	Metropolitan
	Non-metropolitan
School socio-economic status	Five quintiles based on the postcode-derived Education and Occupation Index, one of the ABS Socio-Economic Index for Areas (SEIFA) indices.[1]

The population reference used was the ACER Sampling Frame, and the maximum possible number of weighting classes across the population was 240.

Weight classes were not maintained if fewer than five schools were present in the weighting class in most cases. Where this standard was not met, weight classes with small numbers of schools were collapsed to form a larger class, usually working backwards through the components outlined above. Jurisdictions were not collapsed together.

Following the initial formation of weighting classes, the distribution of data within weight classes by student gender was examined. A weight adjustment was made so that the weighted number of boys and girls in the weighting class matched the population for that class. In some cases, due to single-gender schools, the number of schools in the newly formed weighting classes was reduced to below five after considering the gender of students. In these cases, another round of collapsing was undertaken to maintain a minimum of five schools per weighting class. While weighting was quite successful in aligning the data from students participating in PAT assessments available from the OARS database to the population distributions, it can only attempt to ameliorate the potential biases arising from the differences between the distributions of students in the OARS database and the general population. The assumption that students who have completed PAT tests and were used for weighting are fully representative of the subpopulation from the weighting class cannot be verified.

1 Australian Bureau of Statistics (2016), Table 1 Postal Area (POA) SEIFA Summary, 2016, 2033.0.55.001 Socio-Economic Indexes for Australia (SEIFA), 2016, accessed January 2020

Table 4 shows the weighted distribution of students comprising the norm sample by state/territory and sector compared with the population distribution calculated from the ABS Schools Data, Table 42b Number of Full-time and Part-time Students.[2]

Table 4 *Weighted distribution of students versus population distribution*

		Government		Catholic		Independent	
	State	Weighted sample %	Population %	Weighted sample %	Population %	Weighted sample %	Population %
Year 3	ACT	2.5	1.7	0.0	2.2	0.0	2.1
	NSW	30.1	31.3	47.2	32.6	23.5	30.4
	NT	1.5	1.3	0.0	0.6	0.0	1.1
	QLD	22.3	21.4	0.0	20.0	35.1	21.0
	SA	7.4	6.4	0.0	5.8	6.9	9.4
	TAS	1.4	2.1	0.0	1.9	6.6	1.7
	VIC	23.6	24.5	41.1	27.8	17.6	23.5
	WA	10.9	11.3	11.7	9.1	10.3	10.8
Year 4	ACT	2.7	1.7	0.0	2.5	0.0	2.0
	NSW	31.2	30.7	46.8	31.9	19.1	30.2
	NT	1.6	1.2	0.0	0.6	0.1	1.1
	QLD	20.8	22.4	0.0	20.3	40.6	21.8
	SA	6.1	6.3	0.0	5.6	12.5	9.1
	TAS	1.7	2.2	0.0	2.0	4.9	1.7
	VIC	24.6	24.2	40.9	27.8	14.7	23.2
	WA	11.3	11.2	12.3	9.3	8.0	10.8

2 Australian Bureau of Statistics (2019) Table 42b. Number of Full-time and Part-time Students by Affiliation, Sex, Grade, Age and Indigenous Status, States and Territories, 2006-2020 [data set], Schools, 2020, accessed July 2021.

Table 4 *Cont.*

		Government		Catholic		Independent	
	State	Weighted sample %	Population %	Weighted sample %	Population %	Weighted sample %	Population %
Year 5	ACT	2.6	1.6	0.0	2.5	0.0	1.8
	NSW	30.7	30.8	49.1	31.9	20.5	30.5
	NT	1.5	1.2	0.0	0.6	0.3	1.1
	QLD	21.2	22.4	0.0	19.9	38.0	21.5
	SA	7.4	6.5	0.0	5.5	8.0	8.7
	TAS	1.7	2.3	0.0	2.0	5.4	1.8
	VIC	23.9	24.0	37.6	28.1	19.5	23.7
	WA	11.0	11.2	13.3	9.4	8.3	10.8
Year 6	ACT	2.5	1.5	0.0	2.4	0.0	1.7
	NSW	30.8	30.9	48.8	32.0	20.2	29.8
	NT	1.5	1.2	0.0	0.6	0.3	1.0
	QLD	21.2	22.5	0.0	19.6	37.8	21.4
	SA	7.2	6.5	0.0	5.8	8.9	8.9
	TAS	1.7	2.2	0.0	2.0	4.9	1.9
	VIC	24.0	24.0	38.3	28.3	19.1	24.0
	WA	11.2	11.3	12.9	9.3	8.8	11.3
Year 7	ACT	1.1	1.6	0.0	2.6	3.4	1.7
	NSW	37.3	30.2	55.1	34.1	13.7	28.5
	NT	2.1	1.1	0.0	0.8	0.0	1.0
	QLD	5.1	23.1	0.4	19.3	51.0	21.9
	SA	7.7	6.8	2.5	5.5	6.7	7.3
	TAS	3.3	2.3	0.0	2.2	1.4	1.7
	VIC	29.3	23.7	39.0	26.1	13.8	26.2
	WA	13.9	11.2	3.0	9.5	10.0	11.7

Table 4 *Cont.*

		Government		Catholic		Independent	
	State	Weighted sample %	Population %	Weighted sample %	Population %	Weighted sample %	Population %
Year 8	ACT	1.0	1.6	0.0	2.5	3.5	1.7
	NSW	38.9	29.9	49.9	34.1	13.5	28.5
	NT	2.2	1.1	0.0	0.7	0.0	1.1
	QLD	0.7	23.5	0.0	19.3	55.6	21.4
	SA	9.0	6.9	7.7	5.5	3.8	7.6
	TAS	3.3	2.3	0.0	2.1	1.7	1.8
	VIC	30.8	23.7	35.8	26.2	13.3	26.0
	WA	14.2	10.9	6.5	9.7	8.6	12.0
Year 9	ACT	0.5	1.6	0.0	2.5	3.9	1.7
	NSW	39.4	30.3	51.6	34.2	13.3	28.3
	NT	2.1	1.0	0.0	0.7	0.0	1.0
	QLD	0.6	23.3	0.0	19.5	55.0	21.8
	SA	8.8	6.7	2.6	5.6	5.7	7.6
	TAS	3.4	2.2	0.0	2.1	1.4	1.7
	VIC	31.1	23.9	39.3	26.0	12.4	26.2
	WA	14.1	10.9	6.5	9.5	8.4	11.7
Year 10	ACT	0.8	1.7	0.0	2.4	4.5	1.7
	NSW	9.4	30.3	69.8	34.3	12.2	28.2
	NT	0.0	1.1	0.0	0.6	0.0	0.9
	QLD	1.9	23.0	0.0	19.0	62.9	22.1
	SA	17.3	7.2	1.3	6.0	3.6	7.8
	TAS	3.8	2.2	0.0	2.2	2.7	1.7
	VIC	47.0	24.4	28.2	26.1	2.9	25.8
		19.7	10.2	0.8	9.5	11.3	11.7

Student achievement

Results from PAT Science 1st Edition tests administered to the norm samples of Australian students were used to ascertain the scale score averages and standard deviations of each year level and – assuming a normal distribution – to calculate the percentile ranks associated with achieved scale scores.

The percentile rank of a score is the percentage of students who achieve less than that score. For example, a student with a percentile rank of 75th compared to year 3 has a scale score higher than 75 per cent of Australian year 3 students.

Table 5 and Figure 1 (page 9) show the PAT Science scale score values for given percentile ranks, as well as the standard deviation of achievement, at each year level of the 2023 norms. The 50th percentile represents the mean, or average, achievement of each norm group.

Table 5 *Student achievement by year level*

Percentile rank	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
95th	134.5	136.2	136.2	137.1	137.6	139.6	140.5	143.6
75th	123.4	125.8	127.2	128.6	129.7	131.4	132.7	135.0
50th (mean)	115.7	118.6	120.9	122.7	124.2	125.7	127.2	129.0
25th	108.0	111.4	114.5	116.8	118.7	120.0	121.8	123.1
5th	96.9	101.0	105.5	108.3	110.8	111.8	114.0	114.5
Standard deviation	11.4	10.7	9.4	8.8	8.3	8.8	8.1	8.8

Differences between 2008 and 2023 norms

There are only very small differences in mean student achievement between the 2008 and 2023 PAT Science norm updates. At every year level, 3–9 the difference in mean student achievement is less than one scale score point. At year 10, the 2023 norm update shows a decrease of 1.6 scale score points in mean achievement compared to 2008. The 2023 standard deviations are slightly larger than in 2008, reflecting an increased spread of achievement at each year level.

While national norms tend to remain relatively stable over time, it is relevant that each norm update comprises results from independent student populations: students who were in years 3–10 in 2008, and students who were in years 3–10 in 2019. Additionally, as the OARS data is a self-selected sample, the means may still not fully represent the Australian population even after linking to the Australian sampling frame and weighting.

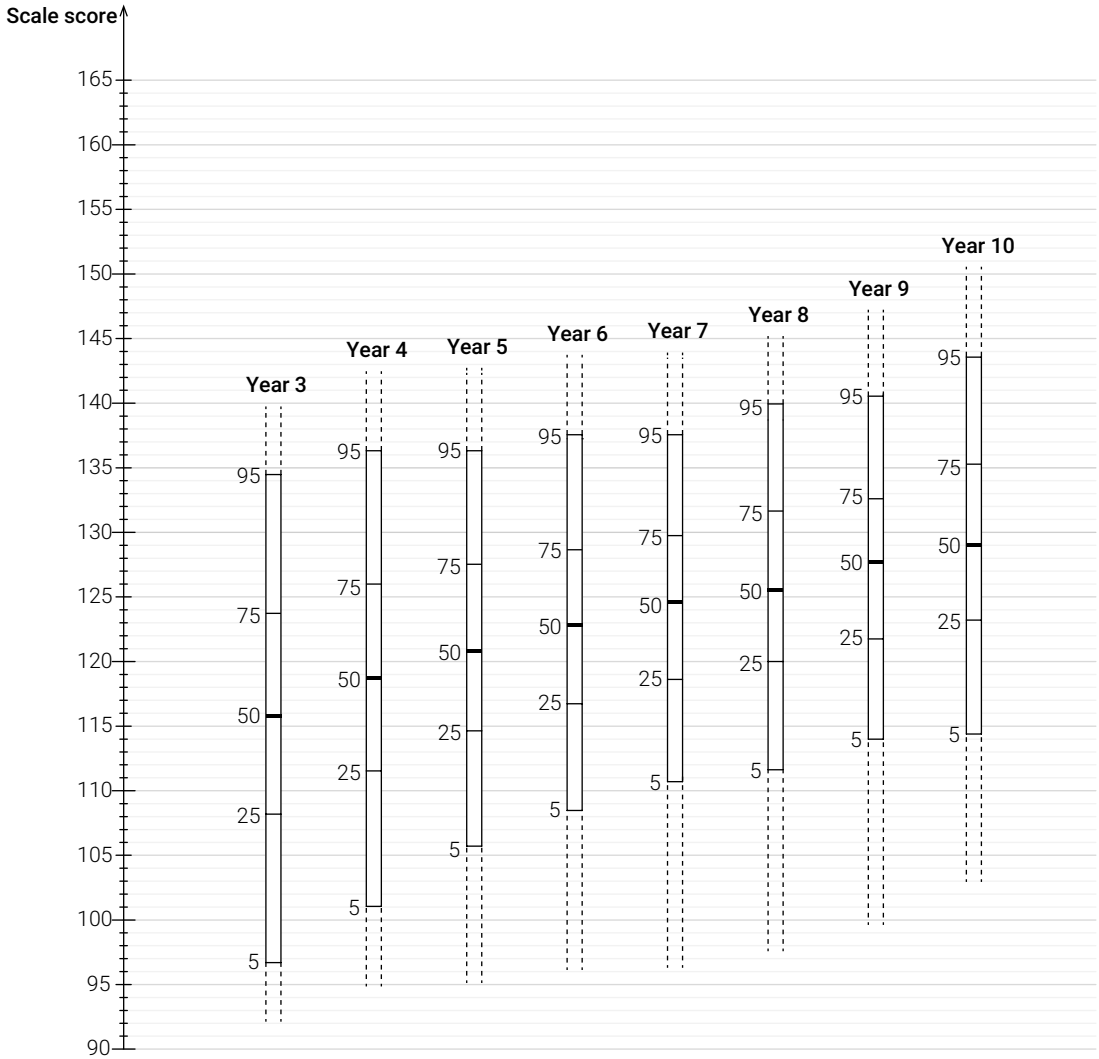


Figure 1 *Student achievement by year level*