

# Getting the funding right:

## Using the *Family Occupation and Education Index (FOEI)* to identify disadvantage in NSW government schools

For many years governments have tried to address the equity problem that students coming from poorer backgrounds are likely to be educationally disadvantaged and have lower levels of achievement.

NSW has recently signed on to the new National Education Reform Agreement (NERA), which changes the method for funding students from poorer backgrounds. A resource allocation model has been developed for government schools in NSW which will include a loading for students with disadvantage.

The Centre for Education Statistics and Evaluation (CESE) has developed a new measure of school socio-economic status (SES), the Family Occupation and Education Index (FOEI), to accurately identify levels of socio-economic disadvantage.

This Learning Curve outlines what FOEI is, how it assesses disadvantage and makes comparisons with other related measures.

### What is FOEI?

FOEI is a school socio-economic index that is based on parents' highest level of school education, non-school qualification and occupation status. This information is captured on school enrolment forms and recorded in the Enrolment Registration Number (ERN) system. Data is extracted in early Term 2 each year.

FOEI includes all students, enrolled in all NSW government schools, including preschool students and Schools for Specific Purposes (SSP).

FOEI uses a statistical method to weight and combine parent information into an index that represents each school's average socio-economic disadvantage relative to other NSW government schools.



## Why do we need FOEI?

The new national Schooling Resource Standard used in the National Education Reform Agreement (NERA) includes needs-based funding or 'loadings' for all students from the most disadvantaged half of the population. The rate of funding is determined by the concentration of disadvantage in each school.

Under NERA, each state government is required to introduce its own needs-based funding arrangements that are consistent with the federal model, and to publish both the actual funding allocations and how they have been calculated.

During 2012-13, the Department of Education and Communities (DEC) has been developing a new Resource Allocation Model (RAM) which includes a loading for students from socio-economically disadvantaged backgrounds. FOEI provides the measure of SES disadvantage for this loading.

## What does FOEI look like?

FOEI is a score ranging from 0 to approximately 300, with a mean of 100 and a standard deviation of 50. Higher FOEI scores indicate higher levels of need (i.e. lower SES.)

In addition to the overall school FOEI score, the distribution of students across FOEI quarters is also used in the resource allocation model. To generate each school's quarter distribution, an SES score is calculated for each student from a combination of parent education and occupation information. From the DEC-wide distribution of students' scores, the cut-points for the 25th, 50th and 75th percentiles are located and used to assign each student to a quarter. For

each school, the percentage of students in each quarter can then be determined.

Schools with similar quarter distributions will not necessarily have similar FOEI values. Each quarter covers a range of possible student parental background scores and the distribution of students within each quarter can vary from school to school.

## What is FOEI composed of and why?

FOEI has been in development since 2009. It was developed as a measure of SES, which for children and young people is typically measured in the research literature by three core, inter-related components (eg. Butler, 2012; and Marks et al., 2000):

- level of parental education,
- parental occupational status, and
- family/parental wealth.

Analysis undertaken by DEC confirmed previous research findings that parental education attainment is one of the strongest predictors of student and school performance. If parental occupation is added to this, the predictive power is further enhanced. Collectively, parental education level and occupation status accounts for more than 70 per cent of the variation in performance across schools.

Although factors such as Aboriginal background and school remoteness impact on student and school achievement, these factors have separate loadings in the RAM to address the associated disadvantage. FOEI therefore only includes core socio-economic factors (i.e. parental education level and occupation status).



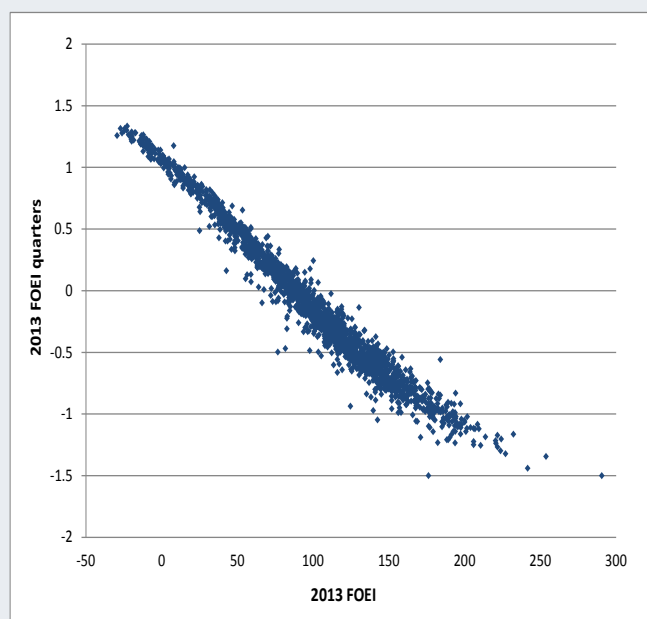
## How do we know that FOEI is accurate?

FOEI has been **validated against other measures** including the Priority Schools Funding Program (PSFP) index and the Index of Community Socio-Educational Advantage (ICSEA). FOEI aligns well with both indices, with differences attributable to the underlying data and methodology. If FOEI is adjusted to include similar components as PSFP and ICSEA (i.e. Aboriginal background), it has greater predictive power for school performance than either of the other two measures.

There is also a **high level of agreement between school-level FOEI values and the distribution of students across FOEI quarters**. This issue was a concern for principals in relation to ICSEA where it has been possible for relatively advantaged schools, according to ICSEA values, to also have high proportions of students in the lowest two quarters, and vice versa.

Such misalignment casts doubts on the validity of both measures. Figures 1 and 2 demonstrate the greater alignment between FOEI and its quarter data than for ICSEA and its quarter data. Points that are more tightly clustered around a straight diagonal line indicate better alignment between the school-level measure and the quarter data.

**FIGURE 1**  
Alignment of FOEI values and quarters



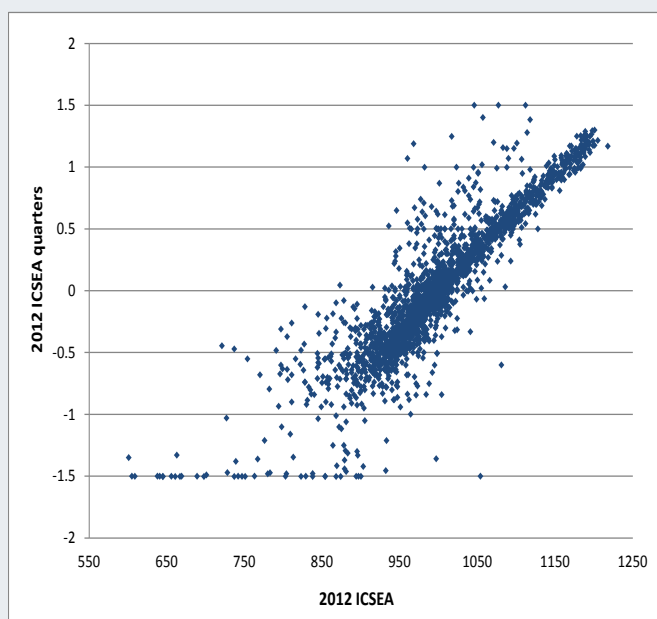
The National Institute for Applied Statistical Research Australia at the University of Wollongong has **independently reviewed and validated** the process used to obtain the FOEI. This same organisation participated in the ICSEA Advisory Group that provided expert advice to the Australian Curriculum, Assessment and Reporting Authority (ACARA) Executive on enhancing the process for the calculation of ICSEA in 2013.

**Refinements to FOEI in 2013 make it the best available SES measure**, as a basis to allocate resources to NSW government schools enrolling students from low SES backgrounds. FOEI is stable for most schools from year to year, with variations clearly relating to changes in the underlying data. FOEI in 2013 correlates strongly with FOEI in 2012.

**FOEI will be subject to a process of continuous improvement.** This will involve an annual review of the methodology, and continued efforts to work with schools and principal networks to improve the completeness and quality of data recorded in the enrolment system.

Because FOEI will now form the basis of equity funding allocations in RAM, CESE will partner with DEC's Audit Directorate to regularly monitor changes in the student background data including parental information.

**FIGURE 2**  
Alignment of ICSEA values and quarters



Technical note 1: Quarter distributions for each school have been combined into a composite measure by summing each quarter multiplied by the following factors: Q1 by -1.5, Q2 by -0.5, Q3 by 0.5 and Q4 by 1.5.

Technical note 2: The FOEI calculation initially produces some negative FOEI values which are preserved in the graph above for analysis purposes. When used in RAM, negative values are converted to a value of 0.

## Why can't we use existing measures of school disadvantage?

FOEI is a better and more responsive measure than ICSEA or PSFP for funding NSW government schools with students from socio-economically disadvantaged backgrounds, as Table 1 shows.

**TABLE 1**  
Comparison of FOEI with other existing measures

	FOEI	ICSEA	PSFP
<b>CURRENCY</b>	FOEI is based on an annual extract of data from the enrolment system, so it captures information about the latest student population enrolled in each school.	ICSEA will always be two years out of date if used in funding for NSW government schools. Funding calculations for a given year (e.g., 2014) begin in the year prior (e.g., 2013), however at that point in time the only ICSEA data available is from the previous year (e.g., 2012).	The PSFP survey was only conducted every four years.
<b>RELEVANCE</b>	FOEI is based only on NSW government school students, resulting in an index that is specific to NSW government schools educational contexts.	ICSEA is a national measure and includes both government and non-government schools, so the distribution of ICSEA values and student quarters reflects all schools and students across Australia. For example, only around 20 per cent of NSW government students are in the bottom ICSEA quarter nationally. However, the state distribution of low SES funding needs to apply the greatest loadings to the bottom 25 per cent of students in NSW government schools.	The PSFP index is only relevant for approximately 50 per cent of schools.
<b>SCOPE</b>	FOEI can be calculated for all NSW government schools.	ICSEA values and quarters are not available for all schools. On the My School website, around 140 NSW government schools are missing ICSEA values and around 180 are missing ICSEA quarter data.	Data is only available for schools that participated in the PSFP survey.
<b>COMPOSITION</b>	FOEI is based only on core socio-economic background factors. (Note that RAM already includes funding components to address the educational disadvantage associated with other factors such as Aboriginal background and remoteness.)	ICSEA is based on factors additional to core socio-economic background factors. As ICSEA is used for comparing and interpreting school performance it includes additional student background factors (i.e. Aboriginal background, remoteness) that relate to performance.	The PSFP index also includes additional factors such as Aboriginal background.
<b>STABILITY</b>	FOEI uses a robust regression technique to manage outliers (i.e. schools that do not fit the model as they exhibit a different pattern of relationship between parental background factors and school performance), resulting in a more stable model for FOEI values.	ICSEA is based on a regression technique that is susceptible to outliers. This contributes to year-to-year variation in ICSEA values for all schools.	The PSFP index also uses a regression technique that is susceptible to outliers.
<b>ACCURACY</b>	FOEI uses direct student enrolment data and has an established and principled method to reduce bias due to missing data.	ICSEA deals with missing parental data by either ignoring it or by constructing ICSEA from a different set of variables (i.e., 'community level data' from the ABS census data linked to student addresses). For 2012 ICSEA values reported in My School in 2013, 286 (14 per cent) schools had ICSEA values based on census data rather than direct parent data. Therefore ICSEA values are not strictly comparable across all schools.	The PSFP index is based only on a sample of parents for most schools. Missing data rates were low, but when parental data was missing it was ignored.
<b>COST</b>	FOEI has been developed, and will continue to be supported by CESE.	Reliant on a third party to develop, support and disseminate a measure (although currently free-of-charge.)	The PSFP survey is very costly and a burden on schools.

# FOEI is a high quality index that addresses statistical problems effectively.

## Using established statistical methods to reduce bias arising from missing data

Parental education and occupation questions on student enrolment forms are optional. Although rates of missing data have reduced in recent years, the optional nature of these questions means information about parents is never likely to be complete.

Missing parent information can be a problem because it is not missing completely at random. Schools in less advantaged areas have higher rates of missing data, as shown in Figure 3.

This means that FOEI values could be biased for some schools if students with missing data are excluded from the calculation. In addition, missing data affects the stability of the FOEI scores, particularly for small schools, when levels of missing data change from year to year.

FOEI uses an established statistical methodology to impute values for missing data. This methodology generates multiple plausible values for the missing data based on the observed relationships between parental variables and other related variables for students where data is available. In total, 10

'complete' datasets are produced, each consisting of the existing data and one set of plausible values for the missing data.

For each school, the percentage of parents in each education and occupation category is calculated for each 'complete' dataset and then averaged across the datasets for use in the FOEI calculation. Similarly, the distribution of students across the quarters is calculated for each dataset and then averaged to determine the final quarter distribution.

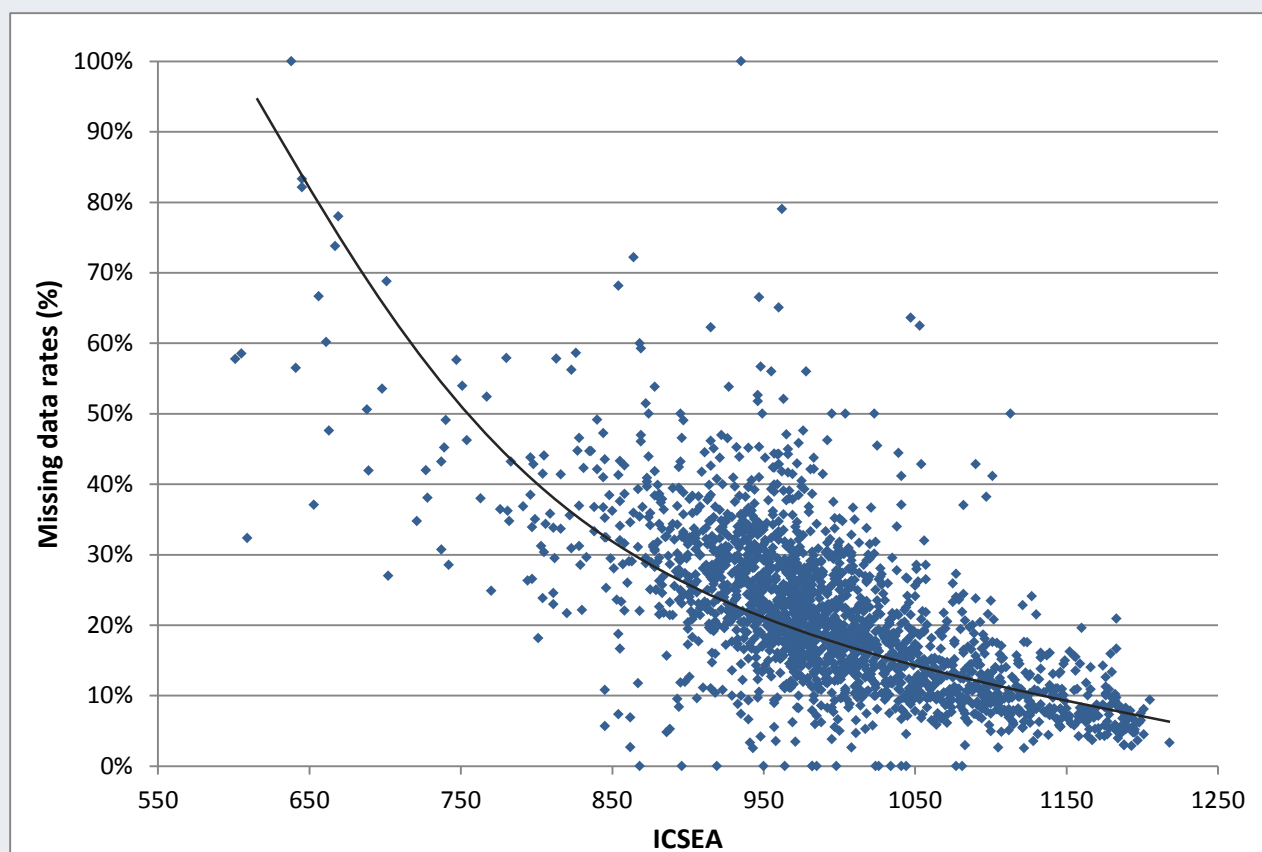
Using imputation has increased the percentage of students whose parental information can be used for FOEI from 61 per cent to 99 per cent.

Validation of the imputed results, using external datasets such as Australian Bureau of Statistics (ABS) data and the PSFP data, show that bias arising from the missing data has been corrected in the right direction.

The overall impact of the imputation method on the distribution of parental variables is that more parents are in the low SES categories, based on post-imputation data compared to the observed data. This indicates that the imputation has helped to produce a more accurate picture of the SES make-up of the parental population in NSW government schools, given the observed pattern of lower SES parents being less likely to provide some background information on student enrolment forms than parents of higher SES backgrounds.

FIGURE 3

Rates of missing data for parental non-school qualifications by ICSEA





## Using a robust modelling technique to reduce the undue influence of outliers

Outliers are statistical anomalies that introduce unwanted volatility in a measure, if not dealt with effectively. Some variation in FOEI values is always expected when there are changes in the underlying parental data for schools (eg. students change on a yearly basis).

Unwanted variation can occur when the statistical regression model changes from year to year due to the presence of outliers, which for FOEI are schools that do not show a typical relationship between parental background characteristics and performance.

CESE analysis shows that the majority of outliers are small schools and selective schools. A few outliers can result in a model that does not best reflect the majority of schools.

CESE's examination of alternative regression techniques showed that the best way to reduce the influence of these outliers and improve the stability of the FOEI model from year to year, is to use a technique known as robust regression.

This technique, used to generate the model for calculating FOEI values, allows all schools to contribute to the overall model as a function of how well they fit the predominant pattern.

## Additional data treatment practices further strengthen the quality of FOEI.

### FOEI for SSPs is based on all students

A number of Schools for Specific Purposes (SSPs) have very small or zero permanent enrolments as the majority of students attending remain enrolled, and are counted, at their home school.

To better reflect the socio-economic background of the students attending SSPs, parental background information was used for all students enrolled in or attending SSPs (i.e. both 'census' and 'non-census' enrolments). This increased the number of students upon which the FOEI calculation is based, leading to greater accuracy and stability of FOEI for these schools.

### Equal weighting for students from different family types

In other measures, information for students in single-parent families has been under-represented relative to students with information for two parents. FOEI corrects for this by ensuring that each student's family background information is given the same weight.



## Summary

FOEI is the best SES measure for use as the basis to allocate resources to NSW government schools which enrol students from low SES backgrounds. It is a fairer and more accurate measure than existing measures (PSFP and ICSEA) for identifying relative levels of socio-economic disadvantage among NSW government schools.

More information about the FOEI methodology and analysis results is to be contained in a technical report published on the CESE website:

[www.cese.nsw.gov.au/reports](http://www.cese.nsw.gov.au/reports)

For further information about FOEI contact CESE's Statistics Unit on 02 9561 1234

### Key References:

- Butler, M. (2012). Coherence of measures of socioeconomic status within and across education and training sectors. Report to the Strategic Cross-sectoral Data Committee, March 2012.
- Kenward, M. & Carpenter, J. (2007). Multiple imputation: current perspectives. *Statistical Methods in Medical Research*, 16, 199-218.
- Little, R. J. A., & Rubin, D. B. (2002). *Statistical analysis with missing data* (2nd edition). New York: John Wiley & Sons.
- Marks, G.N., McMillan, J., Jones, F.L. and Ainley, J. (2000). *The Measurement of Socioeconomic Status for the Reporting of Nationally Comparable Outcomes of Schooling*. Draft report to the National Education Performance Monitoring Taskforce.
- Schafer, J. L. (1999). Multiple imputation: a primer. *Statistical Methods in Medical Research*; 8: 3-15.
- Verardi, V. & Croux, C. (2009). Robust regression in Stata. *The Stata Journal*, 9 (3), 439-453.
- White, I., Royston, P. and Wood, A. (2011). Multiple imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine*, 30, 377-399.



Previous Learning Curve publications:

Learning Curve 1 Teaching quality: effective teaching practices for improving student achievement

Learning Curve 2 What works? First findings from the independent evaluation of the National Partnership on Literacy and Numeracy

Learning Curve 3 Turning aspirations into reality: How teachers can support students' transition to university and vocational education and training

Learning Curve 4 Assessing English language proficiency

Centre for Education Statistics and Evaluation  
Office of Education  
GPO Box 33  
Sydney NSW 2001  
Australia  
T 02 9561 1220  
[www.cese.nsw.gov.au](http://www.cese.nsw.gov.au)

NSW Department of Education and Communities