Worked examples for Gorard (GS) and Allen and Vignoles (D) measures of segregation in schools.

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Abstract

This short paper provides some step by step worked examples for two competing measures of segregation in schools, namely those of Gorard (GS) and Allen and Vignoles (D)

1 Introduction

The number of pupils receiving Free School Meals (FSM) is a commonly used measure of economic deprivation in schools. A school where a high proportion of pupils are in receipt of FSM could be considered more economically deprived than a school with a low proportion of pupils receiving FSM.

However such basic comparisons do not easily allow researchers to address the questions of whether some schools have more than their 'fair share' of pupils in receipt of FSM while other schools have fewer pupils receiving FSM then they would if the number of pupils in receipt of FSM was evenly distributed between schools.

This short paper is neither the a discussion of FSM, the merits or demerits of using FSM as an indicator for pupil poverty or a comparison of Gorard's index (GS) with Allen and Vignoles' index (D). It is simply a statement of how the two indexes are calculated using step-by-step examples. Although the examples shown here pertain to FSM, they could be used as for examining other measures of segregation such as race, religion or gender.

The formulae derive from Gorard (2006) and Allen and Vignoles (2007).

2 Important notes about both these indices

GS and D are both indices of segregation between schools. The unit of analysis is a geographical area, possibility a town, county or Local Education Authority (LEA). It is not possible for an individual school to have a GS or D index so at least two schools are required.

The examples here are from an imaginary town with just two schools. There is no limit to the number of schools which could be used.

2.1 Gorard

$GS = 0.5 * (\Sigma|F_i/F - T_i/T|)$ Where:
GS= Gorard's segregation
F_i = Number of pupils in receipt of free school meals at School i.
F = Number of pupils in receipt of free school meals in the region/ geographical area as whole.
T_i = Total number of pupils at School i
T = Total number of pupils in the region/ geographical area as a whole.

2.2 Allen and Vignoles

$D = 0.5 * (\Sigma|F_i/F - N_i/N|)$
Where:
D= Segregation
F_i = Number of pupils in receipt of free school meals at School i.
F = Number of pupils in receipt of free school meals in the region/ geographical area as whole.
N_i = Total number of pupils at School i not in receipt of Free School Meals
N = Total number of pupils in the region/ geographical area not in receipt of Free School Meals.

3 Worked examples

3.1 Example A

Example A is used by Gorard (2006). It is expanded here to provide a worked example to calculate the GS index.
Recall the formulae for the GS index:

$$GS = 0.5 * (\Sigma|F_i/F - T_i/T|)$$

	FSM pupils	Non-FSM pupils	Total
School A	100	100	200
School B	0	200	200
Total	100	300	400

GS centres on the number of pupils in receipt of FSM and the Total number of pupils in the school. Therefore we do not need to pay direct attention to the non-FSM.

	FSM pupils	Total
School A	100	200
School B	0	200
Total	100	400

So F_i is the number of FSM in each school. For School A $F_i = 100$ and for School B $F_i = 0$. F is the number of FSM in the whole town so $F = 100$.
So T_i is the total number of FSM in each school. For School A $T_i = 200$ and for School B $T_i = 200$. T is the total number of pupils in the whole town so $T = 400$.

	FSM pupils	Total	F_i/F	T_i/T	$(F_i/F) - (T_i/T)$*
School A	100	200	$100/100 = 1$	$200/400 = 0.5$	$1 - 0.5 = 0.5$
School B	0	200	$0/100 = 0$	$200/400 = 0.5$	$0 - 0.5 = -0.5$
Total	100	400			

Now we have found $(F_i/F) - (T_i/T)$* for each school we need to add up, namely.
$\Sigma(F_i/F) - (T_i/T)$*
*** NB: The brackets used here are not strictly necessary as multiplication and division should always precede additional and subtract. Thus F_i/F and T_i/T should be calculated before the latter is subtracted from the former.**
However, the formula contains $|\ldots|$ which means we need to use the **absolute value** for each number in the $(F_i/F) - (T_i/T)$ column. The absolute value is the distance a number is from zero, so to put it more simply we ignore any minus signs. So $-5 = 5$, $-2 = 2$ etc.
Whereas:
$\Sigma(F_i/F) - (T_i/T) = 0.5 + -0.5 = 0$ (Incorrect)

Instead we use the absolute value indicated by the absolute value bars($|\ldots|$) which enclose this part of formula:

$|\Sigma(F_i/F) - (T_i/T)| = 0.5 + 0.5 = 1$ (Correct)

$|\Sigma(F_i/F) - (T_i/T)|$ is then multiplied by 0.5

$0.5 \times 1 = 0.5$
Therefore $GS = 0.5$

3.2 Example B

Example B is the same problem as above but uses Allen and Vignoles' formula instead.
Recall the formulae for the D index:

$$D = 0.5 * (\Sigma|F_i/F - N_i/N|)$$

Here is the data for the school repeated again.

	FSM pupils	Non-FSM pupils	Total
School A	100	100	200
School B	0	200	200
Total	100	300	400

D centres on the number of pupils in receipt of FSM (F) and the number of pupils not in receipt of FSM (N)

	FSM pupils	Non-FSM pupils
School A	100	100
School B	0	200
Total	100	300

So F_i is the number of FSM in each school. For School A $F_i = 100$ and for School B $F_i = 0$. F is the number of FSM in the whole town so $F = 100$.
So N_i is the total number of non-FSM in each school. For School A $N_i = 100$ and for School B $N_i = 200$. N is the total number of non-FSM pupils in the whole town so $N = 300$.

	FSM pupils	Non-FSM pupils	F_i/F	N_i/N	$(F_i/F) - (N_i/N)$*
School A	100	100	$100/100 = 1$	$100/300 = 0.33$	$1 - 0.33 = 0.66$
School B	0	200	$0/100 = 0$	$200/300 = 0.66$	$0 - 0.66 = -0.66$
Total	100	300			

Now we have found $(F_i/F) - (N_i/N)$* for each school we need to add up, namely: $\Sigma(F_i/F) - (N_i/N)$* (* See note above regarding brackets). As in the case of GS the formula contains absolute value bars |...| which means we need to use the **absolute value** for each number in the $(F_i/F) - (T_i/T)$ column. The absolute value is the distance a number is from zero, so to put it more simply we ignore any minus signs. So $-5 = 5$, $-2 = 2$ etc.
Whereas:
$\Sigma(F_i/F) - (N_i/N) = 0.67 + -0.67 = 0$ (Incorrect)

Instead we use the absolute value:

$|\Sigma(F_i/F) - (N_i/N)| = 0.67 + 0.67 = 1.34$ (Correct)

$|\Sigma(F_i/F) - (N_i/N)|$ is then multiplied by 0.5

$0.5 \times 1.34 = 0.67$
Therefore $D = 0.67$

4 Notes

If actual values are used instead of absolute values the $\Sigma F_i/F - T_i/T$ and $\Sigma F_i/F - N_i/N$ will always equal zero.

5 References

Allen, R. and Vignoles, A. (2007) What should an index of school segregation measure? *Oxford Review of Education*, 33 (5). pp. 643-668
Gorard, S. (2006) *What does an index of school segregation measure? A commentary on Allen and Vignoles.* University of York. Department of Educational Studies Research Paper 2006/04
Gov UK (2014). Apply for Free School meals. Available at: https://www.gov.uk/apply-free-school-meals

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