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A note on ‘The limitations of school league tables to inform school choice’

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Summary. In earlier work, we showed that, for any given year, England’s secondary school league tables poorly predict schools’ future performances. We generalize our prediction formula to calculate predictions based on multiple years of school league table data and show that this does very little to improve precision. This reinforces the conclusion of our earlier work: school league tables are unreliable and misleading guides for school choice and that this is still the case even if several years of school league table data are considered.

Keywords: Multilevel models; School choice; School league tables; Value-added models

1. Introduction

In Leckie and Goldstein (2009), we argued that a fundamental limitation of England’s ‘contextual value-added’ (and traditional) secondary school league tables (`http://www.education.gov.uk/performancetables/`) is that schools’ published performances are based on children who began secondary schooling 7 years before the time when those currently choosing will enter their schools. Thus, the relevant information for those choosing is instead how schools will perform in the future (see Goldstein and Leckie (2008) for a non-technical treatment of this issue). Our earlier work presented a formula for predicting schools’ future performances based on their current performances and this demonstrated that predictions were so uncertain that almost no schools could be distinguished from the overall average, or from one another, with an acceptable degree of precision.

In this note, we generalize our prediction formula to allow predictions to be based on multiple years of school league table data. This enables us to investigate whether such additional data lead to more precise predictions. Specifically, we consider the cohort of children who used the 2009 tables to choose secondary schools in the autumn of 2010 and who will take their General Certificate of Secondary Education examinations and complete their compulsory secondary schooling in 2016. We apply our generalized prediction formula to predict school effects for this 2016 cohort on the basis jointly of 8 years of school league table data, 2002–2009. We compare these predictions with those based only on the 2009 data and show that incorporating the earlier years of school league table data in the predictions does very little to improve precision.

2. Generalized prediction formula

Consider the general case of predicting cohort K school effects from data that are available for $L=K-1$ earlier cohorts. (This generalizes the special $K=2$ case that was specified in our earlier

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work.) The general, random-coefficients two-level (pupils within schools) multilevel model for K cohorts can be written as

$$\left.\begin{array}{c} Y_j^{(L)} = X_j^{(L)} B^{(L)} + Z_j^{(L)} + U_j^{(L)} + E_j^{(L)}, \\ Y_j^{(K)} = X_j^{(K)} B^{(K)} + Z_j^{(K)} + U_j^{(K)} + E_j^{(K)}, \\ \begin{pmatrix} U_j^{(L)} \\ U_j^{(K)} \end{pmatrix} \sim N\left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \Omega_{U(L)} & \\ \Omega_{U(L,K)} & \Omega_{U(K)} \end{pmatrix} \right\}, \qquad \begin{pmatrix} E_j^{(L)} \\ E_j^{(K)} \end{pmatrix} \sim N\left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \Omega_{E(L)} & \\ 0 & \Omega_{E(K)} \end{pmatrix} \right\} \end{array}\right\} \tag{1}$$

where $Y_j^{(L)}$ is the vector of General Certificate of Secondary Education scores for the first L cohorts of pupils in school j, $X_j^{(L)}$ and $B^{(L)}$ and are the corresponding matrix of predictors and vector of parameters for the fixed part of the model, $Z_j^{(L)}$ and $U_j^{(L)}$ are the corresponding matrix of predictors and vector of cohort-specific school random effects for the random part of the model and $E_j^{(L)}$ is the vector of pupil level random effects. (See Goldstein (2011) for further technical details of multilevel modelling.) The terms in the second equation relate to cohort K and are defined in an analogous fashion to those in the first equation. (The contextual value-added model that is used by the government is the random-intercepts $K=1$ version of this model.)

The school and pupil random effects are assumed to be multivariate normally distributed, each with mean zero vectors and unstructured variance–covariance matrices. It follows that the distribution of $U_j^{(K)}$ given $\tilde{Y}_j^{(L)} = Y_j^{(L)} - X_j^{(L)} B^{(L)}$ is also multivariate normal. The mean of this conditional distribution provides estimates of the cohort K school effects based only on data for the L earlier cohorts, namely

$$E(U_j^{(K)} | Y_j^{(L)}) = \Omega_{U(K,L)} Z_j^{(L)\mathrm{T}} (Z_j^{(L)} \Omega_{U(L)} Z_j^{(L)\mathrm{T}} + \Omega_{E(L)})^{-1} \tilde{Y}_j^{L}. \tag{2}$$

Similarly, the covariance of this conditional distribution gives the formula for the 'comparative' covariance matrix, which is used to give confidence intervals for these estimated school effects:

$$\mathrm{cov}(U_j^{(K)} | Y_j^{(L)}) = \Omega_{U(K)} - \Omega_{U(K,L)} Z_j^{(L)\mathrm{T}} (Z_j^{(L)} \Omega_{U(L)} Z_j^{(L)\mathrm{T}} + \Omega_{E(L)})^{-1} Z_j^{(L)} \Omega_{U(L,K)}. \tag{3}$$

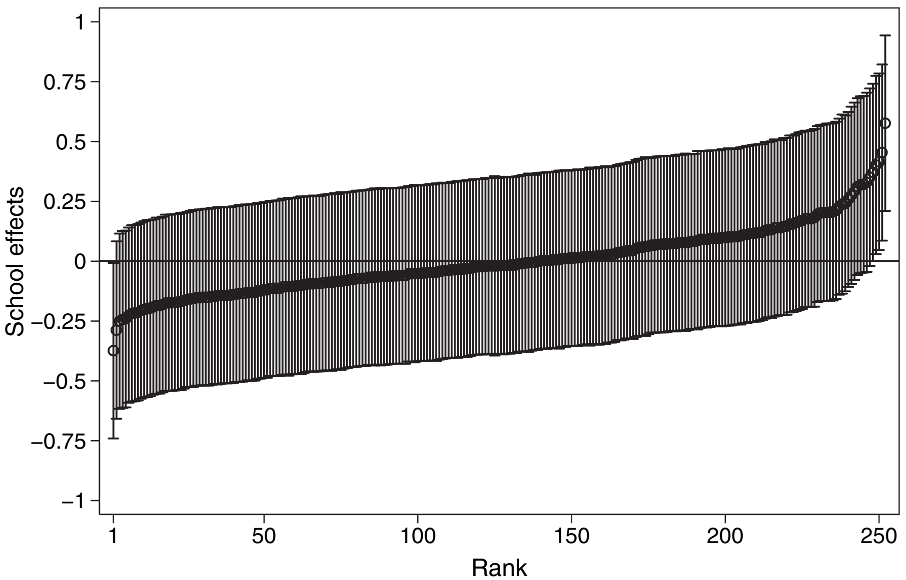
Estimates for equations (2) and (3) can be obtained by substituting sample estimates for the model parameters.

3. Results

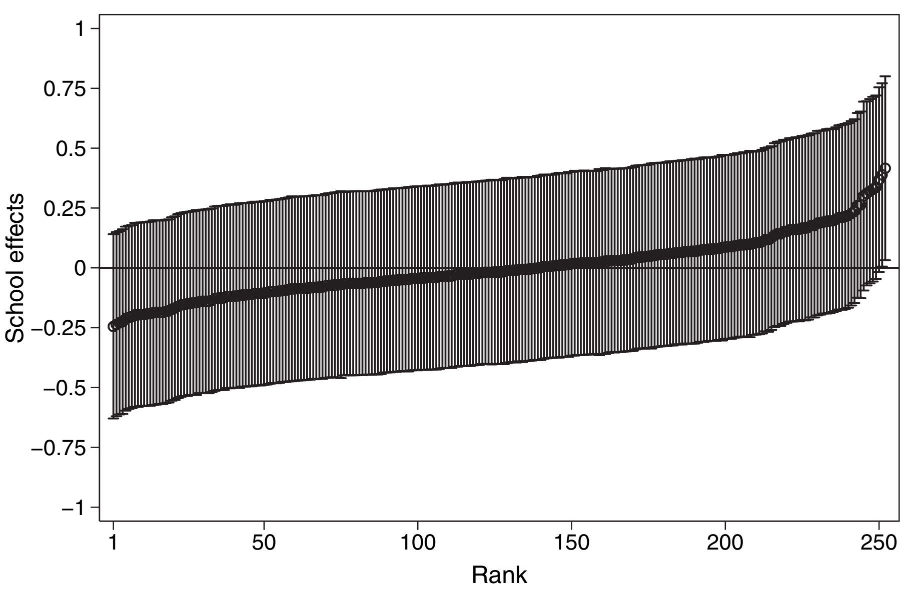
We analyse the same representative 10% sample of English secondary schools as considered in our earlier work, but we now additionally include the two most recent years of league table data, 2008 and 2009. In total, the sample therefore consists of eight cohorts of pupils who completed their General Certificate of Secondary Education and compulsory secondary schooling between 2002 and 2009. We start by fitting a version of model (1) jointly to the eight cohorts where we follow the model specification of the government's contextual value-added random-intercepts model as closely as possible. We then use equations (2) and (3) to calculate the conditional estimates and 95% confidence intervals for the 2016 cohort school effects on the basis of the data that are available for all eight cohorts. Estimates for the parameters of the two covariance matrices $\Omega_{U(K)}$ and $\Omega_{U(K,L)}$ specified in equations (2) and (3) are not provided by the model. The first parameter $\Omega_{U(K)}$ is the 2016 between-school variance whereas $\Omega_{U(K,L)}$ is the vector of covariances between the 2016 school effects and the 2002–2009 school effects. We set $\Omega_{U(K)}$

equal to the average of the between-school variance estimates for 2002–2009. We reparameterize $\Omega_{U(K,L)}$ as a vector of correlations and then assign values to these correlations which are informed by the rate of decay of the 1–7 year-apart correlations estimated by the model.

Fig. 1(a) plots the estimates for the future school effects for the 2016 cohort based jointly on all 8 years of league table data, 2002–2009, whereas Fig. 1(b) plots estimates based only on the



(a)



(b)

Fig. 1. School effects for the 2016 cohort presented with 95% confidence intervals based jointly on (a) eight earlier cohorts, 2002–2009, and (b) only the 2009 cohort

2009 league table data. (Fig. 1(b) corresponds to Fig. 4 in Leckie and Goldstein (2009), except that our focus there was on the 2007 league table data.) The results suggest that incorporating the seven earlier years of school league table data in the predictions only marginally improves precision. Thus, we still cannot predict whether schools in our sample in 7 years' time will perform differently from the overall average, or from one another, with an acceptable degree of precision.

An examination of the rate of decay of the 1–7-year-apart correlations estimated by the model reveals that it is approximately log-linear in the time difference in years. This implies a first-order auto-regressive correlation structure for the school effects, which in turn implies zero partial correlations between school effects for different years. This means that the 2002–2008 school league tables add effectively no useful information to the prediction of the 2016 school effects once we have conditioned on 2009 school effects and this is what we have shown in Fig. 1.

4. Conclusions

The results in this note have again shown that schools' future contextual value-added performances cannot be predicted reliably. This reinforces the conclusion of our earlier work: school league tables have very little to offer as guides for school choice and we show that this is still so even if several years of past school performances are considered. The tables published by the government therefore contain uncertainties that cannot simply be removed by using data derived from other years. They continue, therefore, to provide parents with school choice information that is inherently misleading.

Although our discussion has focused on school choice, another main purpose of constructing school league tables is for school accountability. We feel that, used carefully, school league table data can play a role for school accountability, e.g. as monitoring and screening devices to identify schools for further investigation. Further discussion of this issue is given in Leckie and Goldstein (2009).

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References

Goldstein, H. (2011) *Multilevel Statistical Models*, 4th edn. Chichester: Wiley.
Goldstein, H. and Leckie, G. (2008) School league tables: what can they really tell us? *Significance*, **5**, 67–69.
Leckie, G. and Goldstein, H. (2009) The limitations of using school league tables to inform school choice. *J. R. Statist. Soc.* A, **172**, 835–851.