successforall

Multi-Level Modelling: An Introduction

Introduction

1 The purpose of this paper is to introduce and describe multi-level modelling (MLM).

2 MLM is a sophisticated statistical technique, which has the potential to provide a more valid, fair and accurate way of calculating Value Added (VA) scores than other methods. Also, it is used for the calculation of DT scores, which are being calculated for the first time in England on a national basis.

3 The statistical advantage of MLM is that it accounts for the effect that learners have on their own outcome, while considering the specific institution that they attended. Other statistical approaches do not directly recognize the impact that an institution has on an individual's performance, as those approaches treat all learners identically; i.e. as if all learners went to the same school.

4 Additionally, MLM allows reliable scores to be calculated for small cohorts (i.e. where few individual take that subject in that qualification). Other approaches do not have methods to make the necessary adjustments, therefore data from small cohorts tend to be aggregated into larger groups or ignored.

5 Currently, MLM is being adopted by the DfES for calculating pre-16 VA and will be used for the calculation of VA and DT for 16-19 year olds.

The Interaction of Individual and Institutional effects

6 It is important to acknowledge that actual attainment of learners is broadly dependent upon two sorts of factors: individual effects and institutional effects.

7 Individual factors describe the learners themselves; age, gender, previous results, etc. In the context of education, the individual factor most strongly associated with attainment is the learner's ability which is typically measured in terms of prior attainment.

8 Institutional factors relate to the school, college or work based learning provider attended by learners. They can arise from differences in curriculum offered, recruitment and catchment area and a host of other considerations. To appreciate how closely these two sorts of factors interact, we first must assume that both factors are independent.

9 For example, if we know that *every* learner who *ever* attended institution X, achieved 4 A grade A-levels, then the fact that they attend this institution would seem to tell us all we need to know to predict their attainment. Clearly, this is not the case, since just knowing which provider a learner attended is not sufficient to predict their attainment.

10 Similarly, if it was only individual factors that allowed one to completely and accurately predict a person's attainment, then there would be no need to know which provider that individual attended. Everyday experience would say that this is not true; that providers do have an impact on a learner's attainment.

11 As we know that both of these factors are important in predicting attainment, we need to ensure that they are both accounted for in the model used for Value Added and Distance Travelled. The issue is trying to determine to what extent the attainment of a learner depends on their abilities and to what extent it is influenced by the institution that the learner attends.

12 The calculation undertaken by MLM specifically determines the institutional effect on the attainment of a learner, while at the same time taking into account the distribution of the prior attainment of all learners in the national cohort under analysis (e.g. A level Biology). In this sense, which institution attends now becomes an important variable in the calculation of predicted attainment for learners in any subject.

The case of small subjects

13 Another advantage of MLM is that it allows reliable scores for both VA and DT measures to be calculated when there are few learners in the institution cohort. Normally, when few learners are taking a subject in a qualification in an institution (for example, A level Biology), other statistical approaches will tend to produce predictions that are volatile and unstable, that is they change substantially if there is any change in the data. This means that the VA or DT score of a small subject could be very high in one year, and then the next year could be very low. Such volatility is symptom that the scores are biased and they are not clear, fair or valid indicators of performance.

14 To solve this problem, the estimation using MLM is used to produce an adjustment factor (usually known as a shrinkage factor). This factor is a number between zero and one, which is used in the calculation of the average of the scores of each subject, independent of the cohort size. If the cohort is large, the shrinkage factor is close to one, and thus has no effect on the results. If the cohort is small, the shrinkage factor is close to zero, and reduces the score towards the national average. By doing this, the results of small cohorts are now more reliable and less volatile, while the scores for large groups or subjects remain virtually unchanged.

Conclusion

15 Multi-level modelling addresses some of the main limitations of other methods of modelling value added and distance travelled. It provides a valid, fair and accurate way of calculating value added and distance travelled data for the purpose of reflection and improvement and institutional accountability.

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