

A TECHNICAL GUIDE TO CONTEXTUAL VALUE ADDED 2007 MODEL

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WHY DO WE NEED CONTEXTUAL VALUE ADDED (CVA)?

1. The test and examination results attained by pupils provide important information about the effectiveness of a school – for example, the proportion attaining Level 4 at the end of KS2, or the equivalent of 5 good GCSEs at the end of KS4 tells us how many pupils at the school are well prepared for the next stage of their education.
2. When comparing the performance of schools we must also recognise that pupils will have different starting points and that the proportions of pupils at each starting point will vary from school to school. Measures of absolute attainment therefore need to be complemented by measures of the progress made by pupils – the value added - from one key stage to another. Value added measures, which have been in use for some years now, are thus based on pupils' prior attainment – for example, at KS2 progress is measured from KS1 assessments, or at GCSE measured from the KS2 tests.
3. It has, however, long been recognised that other external influences will affect the progress made by pupils – e.g. levels of deprivation. Now that we have a pupil level annual school census, the data from that can be exploited to further refine value added calculations to eliminate the effect of those factors which are outside the control of a school. Contextual Value Added (CVA) therefore not only measures progress based on prior attainment but also adjusts to account for the impact of certain external factors which are known to have had an impact on the progress of individual pupils.
4. This means that CVA gives a much fairer statistical measure of the effectiveness of a school and provides a solid basis for comparisons. Nevertheless, no single measure of performance can tell the whole story about a school's effectiveness and CVA must not be viewed in isolation. Attainment data continues to play an important role in painting the full picture of a school's performance.
5. CVA measures past performance over a given period of time and allows comparisons to be made given what is known about the progress made by pupils during that time and with the same characteristics. **CVA should not be used to set lower expectations for any pupil or group of pupils.** When setting targets for future performance expectations, schools should strive to set equally challenging aspirations for all pupils.

IMPORTANT POINTS TO REMEMBER ABOUT THE CVA MODELS

6. The CVA measure is a statistical means of assessing the relative effectiveness of a school or measuring pupil progress. There are no aspirational expectations for any category of pupils – for example, that most would be expected to attain level 4 by the end of KS2, or attain 5 good GCSEs by the end of KS4. The model is based on the actual test and exam results of the given year group. It calculates the national average results attained by each category of pupil – the statistical ‘prediction’ – and compares each individual’s test/exam results against that prediction.
7. The power of CVA is that it is based on statistical relationships drawn from a national dataset for some 600,000 pupils in each year group in England. But that means that only the data that is collected at national level can be included in the model. Some external factors which are commonly thought might have some impact cannot be included because there is no reliable national data available – e.g. parental education status/occupation.
8. Data availability might also impact on certain groups of pupils at certain key stages. This is because we must have a pupil’s prior attainment test results against which to measure progress. So, for example, for the KS2-4 measure a pupil must have a KS2 test result. That means they would need to have been in an English school some 5 years prior to taking GCSEs. Pupils in KS4 who joined the school from overseas within the past 5 years cannot therefore be included in the CVA measure. This phenomenon will be less marked in CVA calculations covering a shorter period of time – e.g. KS3-4.
9. It is important to remember that CVA is a measure of progress over a period of time from a given starting point and not a measure of absolute attainment. As such it often gives rise to counter-intuitive predictions. For example, one might expect older pupils in KS4 to attain better GCSE results, but the KS2-4 model predictions show that younger pupils make more progress. And this makes sense: younger pupils tend to have been further behind at KS2 and close the gap with their elder peers as they move up through school. The same can be true for other groups of pupils – for example, those for whom English is not their first language tend to make more progress at each successive key stage as the language barriers diminish.
10. Finally, when considering CVA it is important not to look at each coefficient in complete isolation. The model takes each factor into account simultaneously when calculating the coefficients so there will be elements of counter balance throughout, since some characteristics are closely associated with others. For example, the deprivation coefficient might appear relatively small, but part of the impact of deprivation may be accounted for within the effect of low prior attainment, since deprived pupils also tend to have below-average prior attainment. Other groups of pupils may have higher coefficients than expected, but their overall outcomes will depend on whether they have a predominance of other factors such as special needs, mobility or deprivation, which are accounted for separately.

HOW IS A CVA SCORE FOR A PUPIL CALCULATED?

11. Previous value added measures were based on a national median line. The value added score for each student is the difference (positive or negative) between their own 'output' point score and the median (middle) output point score achieved by others with the same or similar starting point, or 'input' point score.

12. If we are to take account of contextual factors then we need a more complex model, but the principle remains the same as for the value added median line approach (VA). We obtain a prediction for the pupil based on national patterns; their contextual value added score being the difference (positive or negative) from this prediction. The particular technique used to derive a contextual value added score is called multi-level modelling (MLM).

13. RAISEonline, the new web-based system for analysing school performance which replaces Ofsted's PANDA and the Department's Pupil Achievement Tracker, will calculate these scores for schools. However, we have provided a Ready Reckoner as an additional resource (also available on this website) that allows an interactive demonstration of how a pupil prediction is built up. Users familiar with regression equations may wish to use the coefficients given in the annex to the Ready Reckoner.

Coverage of CVA

14. CVA covers all maintained schools and non-maintained special schools. Independent schools are not included in the calculations because they do not submit the pupil level school census data upon which the model is built.

15. CVA models have been produced separately for mainstream schools and special schools. Paragraph 31 of this guidance gives details of how these two models differ.

16. The screenshots and charts included in this document are from the KS2-4 mainstream schools Ready Reckoner. Ready Reckoners are also provided for KS1-2, KS2-3 and KS3-4.

We can break the pupil calculation into four stages

Stage 1: We obtain a prediction of attainment based on the pupil's prior attainment.

Stage 2: We then adjust this prediction to take account of the pupil's set of characteristics.

Stage 3: For KS2-3, KS2-4 and KS3-4 we adjust further by taking account of school level prior attainment.

Stage 4: We obtain a contextual value added score by measuring the difference (positive or negative) between the pupil's actual attainment and that predicted by the CVA model.

STAGE 1: Prior attainment

17. Even when we include contextual factors we find that prior attainment is by far the strongest predictor of outcomes.

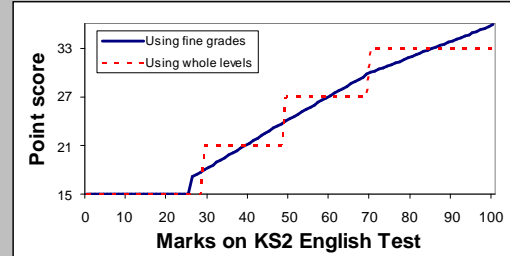
18. In the value added median line approach we take the average point score (based on levels in English, mathematics and science) and use it as our input. Similarly, in contextual value added we use an average point score. We also look at how a pupil's prior attainment in individual subjects differs from their overall average.

19. For point scores at Key Stage 2 and Key Stage 3 we use *fine grades* (see box to the right for further guidance.)

Fine Grades

In the past, point scores have been based on the levels that pupils achieved in Key Stage assessment; pupils achieving level 4 getting 27 points, those at level 5 getting 33 points and so on.

Fine grades use the underlying marks data to create a finer measure.



Pupils achieving the minimum mark available for a level 4 will be assigned 24.0 points, those at the mid point between the level 4 and 5 thresholds 27.0 points and those who missed getting level 5 by one or two marks will be assigned a point score of around 29.9. The Ready Reckoner will enable you to see the conversion from marks to point scores.

20. We use the CVA model to obtain a prediction based on prior attainment. The Ready Reckoner will show the prediction based on a particular set of fine grade point scores. An example is given below.

Key Stage 2 (Prior attainment finely graded point scores)			Notes
To calculate these scores click HERE			
		Difference from Average	Model Adjustment
English	27.6	-1.96	-4.57
Mathematics	30.3	0.74	+0.28
Science	30.78		
Average Point Score	29.56		+338.83
			+334.54

STAGE 2: Characteristics

21. We make adjustments to pupil predictions if the pupil has particular characteristics. The adjustment is the effect of that characteristic on attainment after taking account of all the other factors.

	Characteristics for which we make adjustments
Gender	We allow for the different rates of progress made by boys and girls by adjusting predictions for females.
Special Educational Needs	Pupils who are school action SEN, and those who are on Action Plus or have a statement.
Ethnicity	Adjustments for each of the 19 ethnic groups recorded in PLASC.
Eligible for Free School Meals	Pupils who are eligible for free school meals. The size of this adjustment depends on the pupil's ethnic group. This is because the data demonstrates that the size of the FSM effect varies between ethnic groups
First Language	Adjustment for the effect of pupils whose first language is other than English. The size of this adjustment depends on the pupil's prior attainment. This is because the effect of this factor tends to taper, with the greatest effect for pupils starting below expected levels and lesser effects for pupils already working at higher levels.
Mobility	Pupils who have moved between schools at non-standard transfer times.
Age	We look at a pupil's age within year based on their date of birth.
In Care	Those pupils who have been 'In Care' at any time whilst at this school.
IDACI	A measure of deprivation based on pupil postcode.

To see the adjustment made for each characteristic consult the Ready Reckoner.

What is IDACI?

IDACI is the **I**ncome **D**eprivation **A**ffecting **C**hildren **I**ndex, provided by the Department for Communities and Local Government. It measures the proportion of children under the age of 16 in an area living in low income households.

IDACI is a supplementary index to the Indices of Multiple Deprivation and is given at super output area level. Further information is available from <http://www.communities.gov.uk/publications/communities/englishindices>

Our indicator ranges from 0.00 to 1.00 with 0.14 being around average.

For additional information a lookup facility for matching postcodes to IDACI scores can be access via <http://www.dcsf.gov.uk/inyourarea/>

STAGE 3: School level prior attainment

22. When looking at KS2-3, KS2-4 or KS3-4 value added we observe that, even after allowing for pupil prior attainment and characteristics, the average level and spread of attainment on entry to a school also affects the predicted outcome for a pupil.

23. When calculating contextual value added we take the straight average of pupil prior attainment average point scores (using fine grades) for those pupils included in the school contextual value added score.

24. The standard deviation measures the average “spread” of prior attainment around the average. It is calculated by taking the difference between each pupil’s result and the school average and squaring it. The average of these squared differences is called the variance, and the square root of the variance is the standard deviation, or the “spread of prior attainment” used in the model.

25. The Ready Reckoner will show you typical values for these school level variables and how any value affects a pupil prediction.

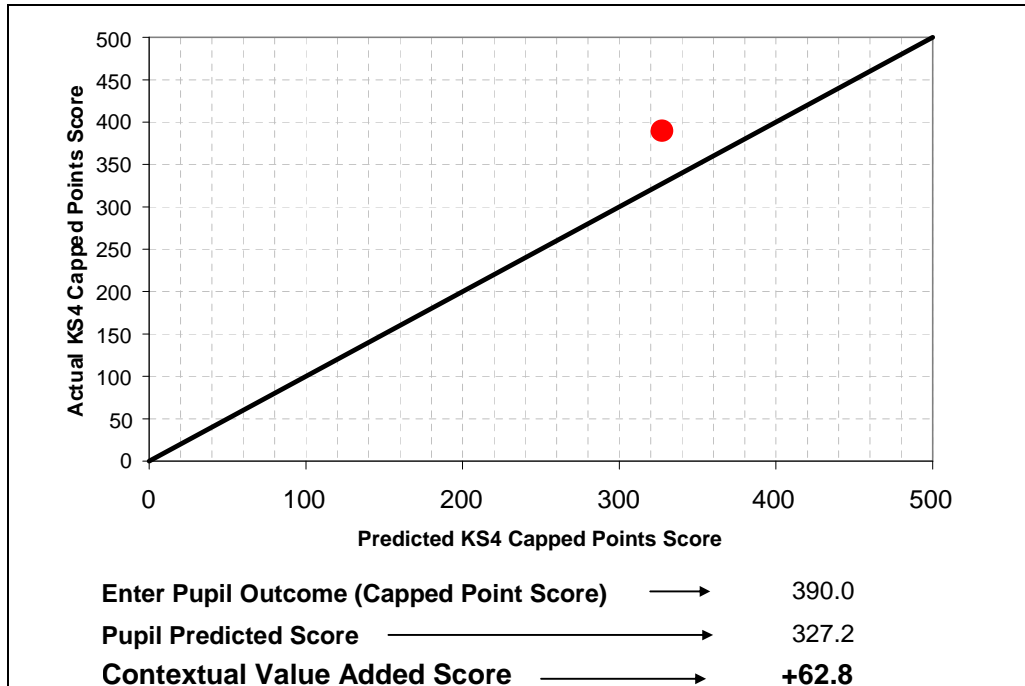
STAGE 4: Obtaining the pupil CVA score

26. Once a pupil prediction has been calculated any KS3 and KS4 predictions which are close to, or above, the maximum are adjusted to more accurately reflect the achievements of pupils at this part of the range.

27. Similarly for pupils with predictions close to or below the KS3 and KS4 minimums, the predictions are adjusted to more accurately reflect the achievements of pupils at this part of the range.

28. For KS2, pupil predictions are constrained at the relevant minima and maxima to ensure they lie within the permissible average point score range for the Key Stage.

29. A pupil’s contextual value added score is then the difference (positive or negative) between their predicted and actual attainment. The actual attainment used is the pupil’s capped “best 8” total point score at KS4, while at KS2 and KS3 it is the fine-graded average point score across the core subjects of English, maths and science.



30. The Ready Reckoner demonstrates this calculation. For schools' use, charts similar to the one above but for all pupils in a cohort are available through RAISEonline.

SPECIAL SCHOOLS MODEL

31. The models for special schools are similar to mainstream, but simplified in places because of the much smaller number of pupils in this sector, both nationally and within individual special schools. The main differences are:

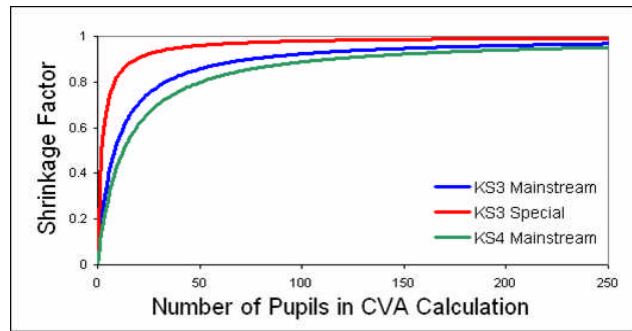
- a. No interaction between FSM and ethnicity. There is a single adjustment for FSM which is independent of the pupils' ethnic background;
- b. No interaction between first language and prior attainment. The adjustment for whether a pupil's first language is other than English is independent of their level of prior attainment;
- c. No school level factors are included in any of the key stage models; and
- d. The 19 ethnic groups recorded in PLASC have been merged to create 8 larger ethnic groups.

MOVING FROM PUPIL TO SCHOOL SCORES

The Shrinkage Factor

32. When calculating a school score using the value added median line approach we take the average (mean) of all pupil scores within that school. With contextual value added we again take the average but we add an extra

step known as the *shrinkage factor*. The shrinkage factor is determined by the number of pupils in a school's cohort (see chart right). It helps us to better estimate contextual value added for schools with small numbers in the calculation.

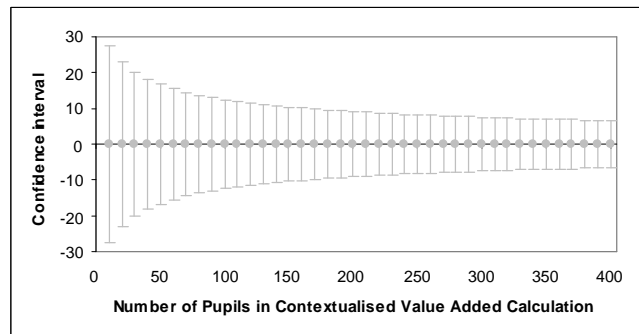


33. We multiply the average of all pupil scores by the shrinkage factor to obtain our final school contextual value added measure.

Confidence Intervals

34. We can use the CVA score as a measure of school effectiveness, but as with VA it is based on a given set of pupils' results for a particular test paper on a particular day.

35. The school could have been equally effective and yet the same set of pupils might have achieved different results on the day. And the school would almost certainly have shown slightly different results with a different set of pupils, even with the same levels of prior attainment. Hence, although the contextual value added score is based on all pupils in the school cohort (not just a sample of them), this degree of uncertainty should be taken into account if interpreting the figures as estimates of a school's effectiveness.



36. The uncertainty of a contextual value added score as a measure of school effectiveness can be presented as a *confidence interval*. This is a range of scores within which we can be statistically confident that the "true" school effectiveness will lie. Like the shrinkage factor, the size of the confidence interval is determined by the number of pupils in the calculation.

37. Smaller schools have larger confidence intervals, even after applying the shrinkage factor, since we are estimating the score on a smaller number of results, so we have less evidence on which to judge a school's effectiveness.

38. The Ready Reckoner demonstrates how different sizes of cohorts lead to different shrinkage factors and confidence intervals. It also shows how the shrinkage factor affects a school score.