department for
children, schools and families

TECHNICAL GUIDE TO

POST-16 CONTEXTUAL VALUE ADDED

2008 MODEL

Version 2 - 09/10/2008

INTRODUCTION

Why CVA?

1. The Level 3 examination results attained by students provide important information about the effectiveness of a school or college – for example, achievement of A level or equivalent qualifications give an indication of how well students are prepared for higher education or employment.

2. When comparing the performance of schools and colleges we must also recognise that students will have different starting points and that the proportions of students at each starting point will vary from institution to institution. Measures of absolute attainment post-16 need, therefore, to be complemented by a measure of the progress made by students – the 'value added' - from the end of Key Stage 4 to the end of advanced level study, otherwise known as Key Stage 5.

3. Contextual Value Added not only measures progress based on prior attainment, but also adjusts for other factors known to impact on student progress. It gives a fairer statistical measure of the effectiveness of a school or college and provides a solid basis for comparisons. Nevertheless, no single measure of performance can provide the whole story about an institution's effectiveness and CVA must not be viewed in isolation. Attainment data continues to play an important role in providing the full picture of an institution's performance. An institution's CVA score should always be considered alongside its 'raw' performance indicators – the Average Point Score per Student and per Entry for A/AS and equivalents.

4. All CVA models are retrospective. They measure past performance over a given period of time and allow comparisons to be made based on what is known about the progress made by students with the same characteristics during that time. Because this will change over time, and because some existing patterns should not become entrenched (- for example boys tending to perform less well than girls), CVA should not be used to determine what students might achieve in the future or in different circumstances.

The Post-16 Model

5. The model developed for the Post-16 Achievement and Attainment Tables is a statistical means of assessing the relative progress made by students at an institution between the end of Key Stage 4 and the end of Key Stage 5. There are no aspirational expectations for any category of student within the model. The model is based on the actual examination results achieved by a given cohort. It calculates the national average results attained by students with the same characteristics within that cohort – the statistical 'prediction' – and compares each individual student's results with that 'prediction'. Students who achieved above the average of their peers attract a positive CVA score, while those below the average attract a negative CVA

score. An institution's CVA score is then the average of its individual students' scores.

6. The power of the model is that it is based on statistical relationships drawn from a national dataset of some 315,000 students in around 2,800 institutions in England. But that means that only comparable data that is collected at national level can be included. The post-16 model differs from those used pre-16 in the Tables in that it does not take account of socio-economic factors, such as ethnicity or deprivation. This is because directly comparable socio-economic data on students in schools and colleges are not yet available. The post-16 model instead includes other factors that national data show impacts on student attainment at Key Stage 5, such as the type of qualification studied and size of learning programme attempted (- otherwise referred to as 'volume of study'). We will consider including socio-economic factors when comparable data become available.

7. The 'raw' performance indicators published in the Post-16 Tables largely capture either the 'quantity' or the 'quality' of level 3 achievement. The Average Point Score per Student gives an indication of the average size of learning programme undertaken by students at an institution (- or 'quantity'), while the Average Point Score per Entry gives the average grade they achieved (- or 'quality'). It is important that the post-16 CVA model measures both the 'quantity' and 'quality' of student achievement. Otherwise students would be able to achieve a high CVA score by entering a larger learning programme without necessarily achieving good grades, or alternatively by achieving very good grades in a much smaller learning programme.

8. Aside from having a statistically significant association with Key Stage 5 outcomes, volume of study has been included in the post-16 model as a statistical means of measuring the 'quantity' and 'quality' of student achievement. At Key Stage 5, national data show that students who choose to attempt higher volumes of study achieve on average better grades than those deciding to do less. Reflecting this, the post-16 model produces higher CVA 'predictions' for those who attempted larger learning programmes.

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 can give rise to counter-intuitive results. For example, one might expect the post-16 model to always show a student who passed four A levels to have achieved higher value added than a student who passed two A levels. However, the model only compares students with other students who attempted qualifications in the same volumes. A student who attempted two A levels may have made more progress than their peers since the end of Key Stage 4, while a student who attempted four A levels may have made less progress.

10. It is equally important not to look at each factor in the model and its coefficient in isolation. The model takes each factor into account simultaneously when calculating a student's CVA.

11. Finally, CVA should not be used to set lower expectations for a student. When setting targets for future performance expectations, schools should strive to set equally challenging aspirations for all students.

THE MODEL IN DETAIL

Overview

12. The Post-16 CVA measure covers the same students as those in the Post-16 Tables provided they have obtained at least one Key Stage 4 pass grade. These students will have completed their advanced or level 3 studies (– otherwise referred to as Key Stage 5) in the reporting academic year, usually over a two year period. All schools (- including independent schools) and colleges, and all approved level 3 qualifications are included.

13. The CVA model 'predicts' each student's Key Stage 5 Total Points Score (KS5 TPS) based on national associations with Key Stage 4 (KS4) prior attainment, gender and volumes of types of level 3 qualifications attempted. Each student's actual KS5 TPS is compared with their 'prediction'. If their actual score is higher than the 'prediction', their CVA contribution (to their institution's CVA score) will be positive. If it is lower, their CVA contribution will be negative. If it is the same, their CVA contribution will be zero.

14. An institution's CVA score is an average of its students' CVA contributions. This score is adjusted by a 'shrinkage factor' and published with a 'confidence interval' (see paragraphs 38-44). For presentation purposes, 1000 is added to the institution CVA scores published in the Tables.

Factors used in the model

15. The CVA model provides a statistical explanation of a student's KS5 TPS by means of a set of explanatory factors (and their interactions) with which data show it is associated. The explanatory factors used are those which are deemed to be wholly or mainly under the influence of students for which comprehensive, high quality, national data are available. They are broadly KS4 prior attainment, volume of level 3 entries by qualification type, gender and their interaction terms.

KS4 prior attainment

16. The most influential explanatory factors, statistically, relate to a student's KS4 achievements. There is, of course, a very wide range of potential KS4 information from which to choose model factors. The following factors covering different aspects of prior attainment have been selected for inclusion in the CVA model:

- Average KS4 point score
- GCSE English Language grade

- GCSE maths grade
- Volume of GCSE attempts at KS4
- Volume of Applied GCSE and other KS4 qualification attempts
- Attainment of English and maths skills at Level 2
- Number of GCSE A/A* grades achieved

17. A student's achievements in all Level 2 qualifications approved for use pre-16 are included. Level 3 qualifications – for example, AS levels - taken in Year 11 (or earlier) included in achievements in the KS4 Tables are excluded from this explanatory factor.

18. The 2008 CVA measure covers students aged 16 - 18 at the start of the reporting academic year. For those aged 16 and 17, KS4 attainments are cumulative up to and including age 15. For those aged 18, KS4 attainments are cumulative up to and including age 16.

19. Average KS4 point score (- uncapped) is the factor most associated statistically with KS5 TPS. The formula used to calculate this aggregate is:

$$\text{Average KS4 points} = \frac{\text{KS4 Total Points}}{\text{KS4 entries}}$$

20. Average KS4 point score is a general measure of prior attainment. Given the same values on other factors, students achieving the same point score will be considered by the CVA model as the same student. But the ways in which their identical scores have been built up may vary. A few, for example, may have achieved the same grade in every KS4 attempt, but most others will have had different grade achievements.

21. The other KS4 factors included in the model provide elements of student differentiation which improves the KS5 TPS prediction. They are:

- **GCSE English Language 'difference'** – this factor is represented by the difference between a student's point score for GCSE English Language and their average KS4 point score. If a student did not have a GCSE English Language entry, the difference is set to zero. GCSE English Literature does not count

- **GCSE Maths 'difference'** – this factor is represented by the difference between a student's point score for GCSE Maths and their average KS4 point score. If a student did not have a GCSE Maths entry, the difference is set to zero. GCSE Statistics does not count

- **GCSE Volume** – the number of GCSE qualifications attempted. Short course attempts have a volume of 0.5

- **Volume of Applied GCSEs and other KS4** qualifications - the volume of

Applied GCSEs and all other KS4 qualifications attempted expressed in full-course GCSE volume equivalents

- **English and Maths skills at level 2** – whether a student has achieved GCSE English and maths, functional skills in English and maths, Basic Skills in literacy and numeracy, or Key Skills in application of number and communication

- **Volume of GCSE A/A* grades –** the number of A/A* grades at GCSE achieved**.**

22. The statistical association between KS4 average points score and KS5 TPS (after taking account of the 'predictive' impact of other factors in the model) is not constant across the prior attainment range. Therefore, two additional factors in prior attainment – the square and cube of the values of KS4 average points score (**Prior Attainment^2** and **Prior Attainment^3**) – have been included in the CVA model to improve student prediction, particularly where student achievement at KS4 is low.

Volume of Level 3 qualifications attempted

23. Students enter a wide variety of qualifications of different types and sizes at level 3. All volumes of qualifications are converted to a 'size' relative to an A level. Thus, an A level has a volume of one, an AS level a volume of a half, and an IB Diploma a volume of five. The relative size of qualifications is further explained in the document *Test and Examination Point Scores* found on the Achievement an Attainment Tables' website.

24. Most students pursue either an academic or vocational qualification 'route'. Many students follow A levels (- holding an additional AS level not taken further), but very significant numbers attempt vocational qualifications – BTECs and NVQ/VRQs – and some take IB. Some students attempt both academic and vocational qualifications. The Post-16 CVA model takes account of the volume attempted by each student in each of the main qualification types as follows:

- A level volume, including Free Standing Maths
- AS level volume
- Applied A level (including Double Award) volume
- Applied AS level volume
- IB volume
- BTEC/OCR volume
- Key Skills volume
- NVQ volume
- VRQ volume

Each student has at least one volume factor, most have two factors, and a minority have three, or more.

25. In line with the calculation of the Average Point Score per Entry for Level 3 qualifications, where a student has an A level fail that has been discounted by an AS pass in the same subject, for the CVA calculation the A level entry counts towards volume while the AS points count towards their points achieved. Where a student has taken an Advanced Extension Award alongside A levels, the AEA does not count towards volume but its points count towards their points achieved.

General Studies

26. During the pilot stage, stakeholders raised a specific issue about whether A and AS level General Studies should be included in the Post-16 CVA model. Stakeholders were overwhelmingly content that General Studies should be included in the measure (thereby maintaining the same qualification coverage as the main Post-16 Tables) with grades and volumes attracting 'half weight' of other A and AS levels. 'Half weight' in this context (applying *only* to the CVA measure and not any other Tables' performance measure) means that the General Studies point score and volume are half the values applied to other A and AS level subjects. In line with the approach in paragraph 25, where a student has an A level fail in General Studies that has been discounted by an AS pass, the A level entry counts towards volume while the AS points count towards the points achieved.

Gender

27. Student gender is included as a factor in the CVA model. In general, females tend to achieve higher KS5 TPS scores than males but, as is noted below, this is dependent on their level of KS4 prior attainment.

Interaction variables

28. Gender, KS4 prior attainment and volume by KS5 qualification type are not independent of one another – as one changes the others change. To take account of these dependencies, the Post-16 CVA model includes interaction terms between the factors. A full list of the factors and interaction terms is in Annex A.

Cohort prior attainment

29. Student outcomes are primarily dependent on their own prior attainments but are influenced by the prior attainments of their peers in the institution. The CVA model includes a factor for the averaged prior attainment (based on student KS4 average points score) over all CVA students in a school or college.

STUDENT CVA CALCULATION

Transforming QCA point scores

30. The 'raw' performance indicators in the main Post-16 Tables are based on the QCA points score system. For A Levels, a grade A attracts 270 points, a grade B attracts 240 points, a grade E attracts 150 points, and so on. The difference between each grade is 30 points. Grade points and the points difference between grades for other Level 3 qualifications are proportionate to their A level-equivalent volume. For example, a grade C at AS Level attracts 105 points, 15 points more than a grade D.

31. 'Fail' grades for any KS5 qualification attract zero points and have a disproportionate effect on student contributions to their institution's CVA score. Points scores have, therefore, been rescaled to remove this impact, but *only* for the Post-16 CVA measure. The 'raw' performance indicators in the Post-16 Tables continue to be calculated using the standard QCA point score system. Transformation of the point scores is largely carried out 'unseen' within the CVA calculation. However, when using the Post-16 CVA Ready Reckoner, you will need to enter the standard QCA points and the rescaled points achieved by students.

32. The QCA points awarded to qualifications is further explained in the document *Test and Examination Point Scores* found on the Achievement and Attainment Tables' website. Transformation is achieved by subtracting 120 points for each A level-equivalent pass grade. For example:

- Student A attempts 3 A levels achieving grades C, D and U
- QCA points = 210 + 180 + 0 = 390
- Subtract 120 points for each pass grade
- Rescaled points = 390 – (2 x 120) = 390 – 240 = 150

- Student B attempts an IB and achieves grade 45
- QCA points = 1380
- Subtract 120 points for each A level equivalent
- Rescaled points = 1380 – (5 x 120) = 1380 – 600 = 780

33. Transforming the point score of, for example, A level grades means that a grade A attracts 150 points, a grade B 120 points and a grade E 30 points. Because the absolute difference in points between grades is retained -

at 30 points for A levels - transformation preserves the interpretation of the CVA score. For example, an institution CVA score of 1030 continues to mean that, on average, students at that institution achieved the equivalent of one A level grade higher than 'predicted' by the model.

Actual and predicted attainments

34. A student's contribution to their institution's CVA score is:

(their Actual KS5 TPS) *minus* (their 'predicted' KS5 TPS)

The 'predicted' KS5 TPS for any student is the addition of their values for each factor (and interaction) multiplied by its coefficient. A full list of factors and interactions are in Annex A.

Capping predictions

35. The CVA model produces a 'predicted' KS5 TPS for every student given their KS4 prior attainment, volumes of KS5 qualifications attempted, and other factors. In a very few cases, these characteristics are such that the model predicts a value that is unattainable. These students tend to have very high or very low levels of KS4 prior attainment. So predictions are either 'capped' - to be the maximum possible attainable - or set to zero if the 'predicted' outcome is negative.

Using the Ready Reckoner

36. The Ready Reckoner provides the information needed to calculate individual student CVA contributions, including the model coefficients. The Ready Reckoner will also produce an institution's CVA score, 'shrinkage factor' and Confidence Interval (CI).

37. Additionally, data from a .csv download file issued to schools and colleges as part of the Tables' checking exercise can be copied into the Ready Reckoner, which will then automatically calculate for an institution the numbers of CVA students and a breakdown of the CVA score by student characteristic.

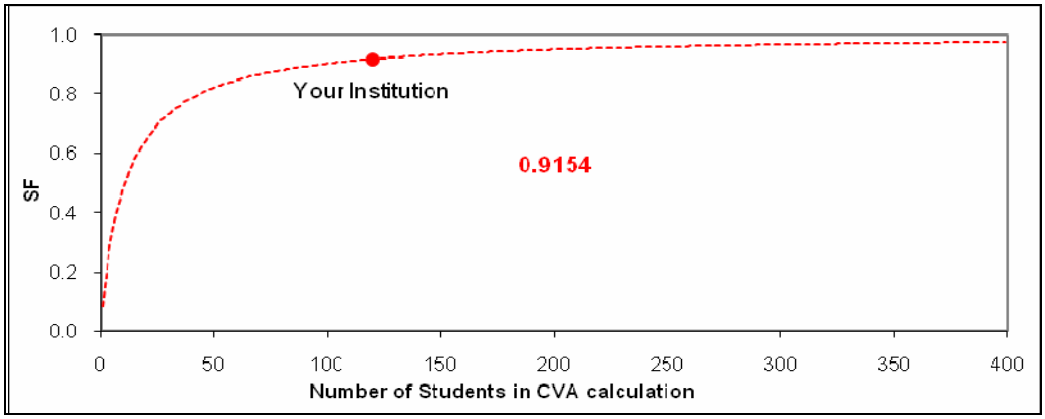
To do this, please see the 'Your CVA Summary' worksheet in the Ready Reckoner.

INSTITUTION CVA SCORE

Shrinkage factor (SF)

38. The CVA model uses a 'multilevel' statistical regression to produce an institution CVA score. This is then multiplied by a 'shrinkage factor' determined by the number of students in an institution's CVA cohort. This allows the model to better estimate the CVA for schools and colleges with small numbers in the calculation. The average of all students' CVA scores is multiplied by the shrinkage factor to produce an institution's final CVA score.

39. The formula for calculating the shrinkage factor can be found in the Ready Reckoner. The Ready Reckoner will produce an institution's shrinkage factor and provide a chart showing this in the context of other institutions of different cohort sizes. An illustrative example of this chart is provided below.



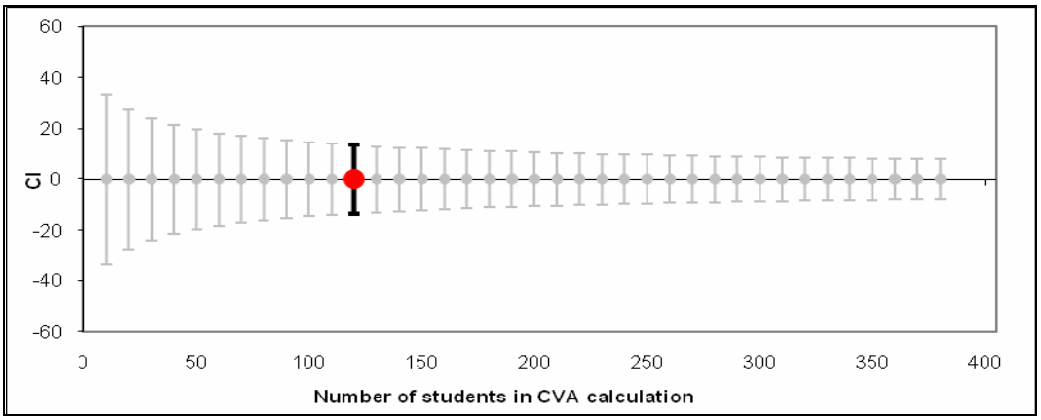
Confidence Interval (CI)

40. While an institution's Post-16 CVA score can be used (- alongside other Post-16 performance indicators) to judge its effectiveness, CVA is based on a given set of students' results in a particular examination on a particular day. A school or college could have been equally effective and yet the same set of student's might have achieved different results on the day. And the school or college would have almost certainly have shown slightly different results with a different set of students. This degree of uncertainty should be taken into account when interpreting CVA figures as estimates of an institution's effectiveness.

41. The uncertainty of a CVA score as a measure of institutional effectiveness can be presented as a 'confidence interval'. This provides a range within which we can be confident the CVA score represents the 'true' effectiveness of a school or college. Like the shrinkage factor, the size of the confidence interval is determined by the number of students in the CVA cohort. Smaller cohorts will have larger confidence intervals, even after applying the shrinkage factor, since the model is estimating the CVA score based on a smaller number of results, so there is less evidence on which to

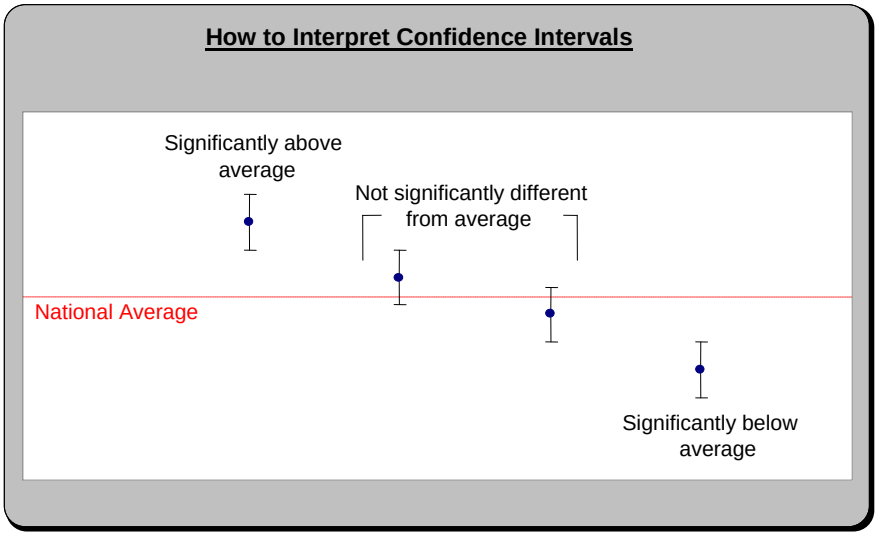
judge an institution's effectiveness.

42. The Ready Reckoner will produce an institution's 95% confidence interval and provides a chart showing this in the context of other institutions of different cohort sizes. An illustrative example of this chart is provided below.



43. The 95% confidence interval of the CVA score provides the interpretation of whether average student progress at an institution can reasonably be deemed to be above, below, or not significantly different from, the national average score.

44. The chart below gives four examples of CVA score interpretation. The CVA score is shown by the 'dot' and the 95% confidence interval by its vertical 'whiskers'. Institutions where the lower limit of the confidence interval is above the national average are institutions where students on average made significantly more progress than students nationally, while institutions where the upper limit of the confidence interval is below the national average are institutions where students made significantly less progress. In the middle two examples below, the upper and lower confidence interval of the institutions' CVA scores cover the national average, so neither would be deemed significantly different from the national average.



45. For presentation purposes, 1000 is added to CVA scores published in the Achievement and Attainment Tables, which are shown alongside their 95% confidence intervals.

Annex A

2008 Model KS4-KS5 CVA Factors and Interactions

Constant
Average KS4 Points (AVGKS4)
Average KS4 Points squared ($AVGKS4^2$)
Average KS4 Points cubed ($AVGKS4^3$)
Difference between GCSE English grade and AVGKS4
Difference between GCSE Maths grade and AVGKS4
Cohort Prior Attainment (average of CVA students AVGKS4)
Female
Male
Volume attempted in GCSEs and Short GCSEs at KS4
Volume attempted in other qualifications at KS4
Achieved Level 2 in English and Maths skills at KS4
Volume of Grades A*-A achieved in GCSEs/ short GCSEs at KS4
KS5 Volume
- Volume in GCE A Levels (GS 'half weight') and free standing maths
- Volume in GCE AS Levels (GS 'half weight)
- Volume in Applied A Levels (including Double Award)
- Volume in Applied AS Levels
- Volume in IB
- Volume in BTEC/ OCR
- Volume in Level 3 Key Skills
- Volume in Level 3 NVQs
- Volume in Level 3 VRQs

Interactions
- AVGKS4 with GCE A Levels (GS 'half weight') and free standing maths
- AVGKS4 with GCE AS Levels (GS 'half weight)
- AVGKS4 with Applied A Levels (including Double Award)
- AVGKS4 with Applied AS Levels
- AVGKS4 with IB
- AVGKS4 with BTEC/ OCR
- AVGKS4 with Level 3 Key Skills
- AVGKS4 with Level 3 NVQs
- AVGKS4 with Level 3 VRQs
- $AVGKS4^2$ with GCE A Levels (GS 'half weight') and free standing maths
- $AVGKS4^2$ with GCE AS levels (GS 'half weight')
- $AVGKS4^2$ with Applied A levels (including Double Award)
- $AVGKS4^2$ with Applied AS levels
- $AVGKS4^2$ with IB
- $AVGKS4^2$ with BTEC/ OCR
- $AVGKS4^2$ with Level 3 key skills
- $AVGKS4^2$ with Level 3 NVQs
- $AVGKS4^2$ with Level 3 VRQs
- AVGKS4 with females
- $AVGKS4^2$ with females
- $AVGKS4^3$ with females