



Department
for Education

Key Stage 2 to Key Stage 4 Value Added Measures

**A technical guide for local
authorities, maintained schools,
academies and free schools**

January 2015

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Introduction to value added

The purpose of a value added measure is to estimate how individual pupils progressed in relation to their peers from the beginning to the end of their compulsory secondary education. This is used for comparing progress of pupils between schools.

This document details how value added measures are calculated at pupil level and how these are used to calculate aggregate measures for specific pupil groups and at school level (as published in the performance tables). Guidance is also given on how to interpret these measures.

Expiry or review date

This technical guide will next be reviewed before October 2016.

Who is this advice for?

This guidance is for:

- local authorities
- school leaders, school staff and governing bodies in all maintained schools, academies and free schools

What is value added?

Pupil's attainment at end of key stage 4 is chiefly affected by two key factors: pupil's attainment at the end of key stage 2 and the impact of their secondary school up to the end of key stage 4. A value added measure aims to estimate the effect of the secondary school on the pupil's attainment taking their key stage 2 results into account.

Value added measures are estimated for each individual pupil by comparing their key stage 4 results with all other pupils with similar key stage 2 results¹. The difference between a pupil's actual key stage 4 performance and their estimated key stage 4 performance gives the pupil their value added score. Each individual pupil's value added score is relative to the performance of other pupils.

Naturally some pupils will progress more than others independently of which school they attend and a school's value added score would certainly be different if they had a different cohort of pupils. Confidence intervals are provided as a proxy for a range within which you can be 95% certain the true value added score lies. These intervals should be taken into account when making comparisons between schools, groups or national averages.

Therefore, the school value added measures that are published in the performance tables are presented alongside the respective 95% confidence intervals. School value added measures estimate the effect of the secondary school on all of their pupil's attainment. A summary diagram shows how to interpret these aggregated scores – see Annex A.

For key stage 4 value added scores, the following measures are calculated:

Key stage 2 to key stage 4 'best 8 plus English and mathematics bonus' value added measure

The 'best 8 plus English and mathematics bonus' value added measure estimates how pupils perform in their best 8 GCSEs (or equivalent qualifications) with pupils receiving an additional bonus for their performance in GCSE English and mathematics, as the point scores for these subjects are counted twice.

¹ Calculated as a key stage 2 fine level, see page 20 for details on this calculation and groupings.

Key stage 2 to key stage 4 English Baccalaureate (EBacc) value added measures

Value added scores are also calculated for the five EBacc subject areas:

- English
- mathematics
- science
- humanities
- languages

A pupil has a separate estimated key stage 4 outcome calculated for each of the five EBacc subject areas. These estimates are then compared against a pupil's best score in each EBacc subject area. For example, if a pupil achieved a B in GCSE geography and a C in GCSE history then it is the GCSE geography result (the pupil's best result in the EBacc humanities subject area) which is used to compare against the estimated key stage 4 outcome for the EBacc humanities subject area value added measure².

A pupil then has a value added score calculated for each subject area by finding the difference between their actual key stage 4 attainment in the subject area and their estimated key stage 4 attainment in the subject area.

All pupils are included in the English and mathematics subject area value added measures. However, only the pupils that have taken the required qualifications at the end of key stage 4 are included in the science, language and humanities subject area value added measures.

² The best score in each EBacc subject area is taken after usual discounting rules have been applied. See page 8 for further guidance on discounting

Interpreting school value added scores

When evaluating a school's performance we must be careful to note that it is based on a given set of pupils' results.

A school could have been equally effective and yet the same set of pupils might have achieved slightly different key stage 4 results, and the school would almost certainly have shown different key stage 4 results with a different set of pupils. This element of uncertainty needs to be taken into account when interpreting a school's value added score; 95% confidence intervals are provided as a proxy for a range in which you can be 95% certain the true value added score lies.

A school's confidence interval is always centred on the school's value added score. For example, if a school's value added score is 1,010 and the size of the school's confidence interval is 5 points, then the confidence interval ranges between 1,005 and 1,015 (ie 5 points either side of the school's value added score).

The size of a confidence interval is determined by the number of pupils in the school at the end of key stage 4 and the standard deviation. In this case the standard deviation used is at the national level for all pupils so the number of pupils at the school is the only influencing factor. Smaller schools have wider confidence intervals because their value added score is based on a smaller number of pupils, so there is less evidence on which to judge the school's effectiveness.

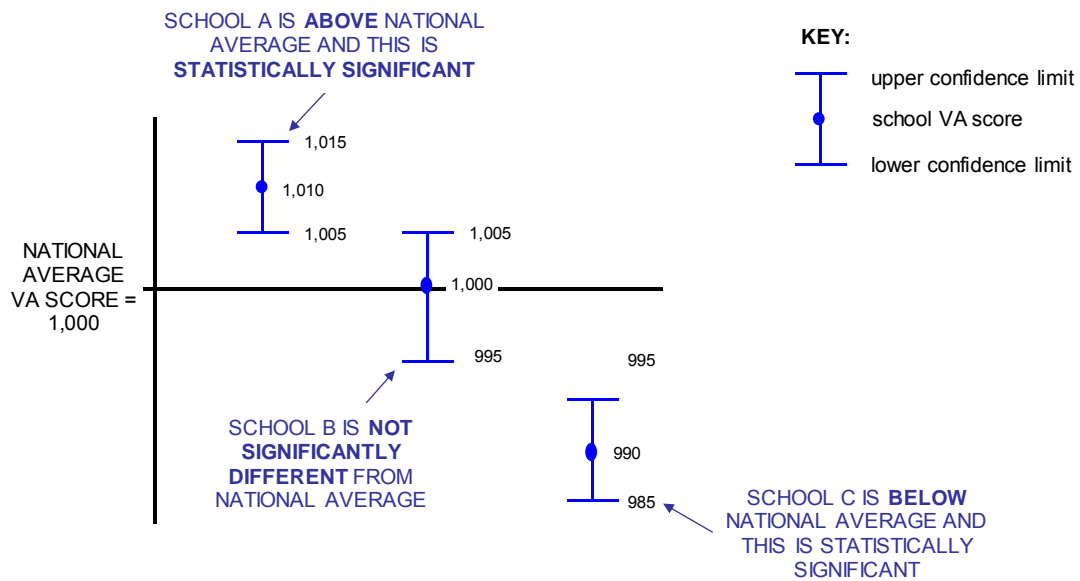
To judge a school's effectiveness, both the school's value added score and the associated confidence interval needs to be taken into account. If the whole range of the confidence interval is above 1,000 (ie the lower confidence limit is greater than 1,000), we can say the school score is *above* the national average and is statistically significant, and we can be confident the school is helping its pupils make better than average progress. An illustration of how to interpret school value added scores is given in Annex B.

Similarly, when the entire range of the confidence interval is below 1,000 (ie the upper confidence limit is less than 1,000), we can say the school score is below the national average and is statistically significant.

Finally, if the confidence interval straddles the national average of 1,000, then we can say that the school is *not significantly different* from the national average, in other words, we cannot confidently say that the schools value added score is definitely above or definitely below the national average.

The table and diagram overleaf show how a school's value added score and confidence intervals should be interpreted to reach one of the three definitions above. School A is an example of a school that is significantly above national average; school B is not significantly different from national average; and school C is significantly below national average.

	School A	School B	School C
School VA Score	1,010	1,000	990
Upper Confidence Interval	1,015	1,005	995
Lower Confidence Interval	1,005	995	985



Note: For more information on the calculation of confidence intervals, please see page 13.

Comparison of English Baccalaureate subject area value added scores

Confidence intervals must also be taken into account when comparing two or more EBacc subject area value added scores within a school (eg when comparing a school's EBacc English value added score with their EBacc humanities value added score).

The size of the confidence intervals for each of the five EBacc value added measures for a school will vary in size (as they are based on different models and different numbers of pupils) – each interval provides a proxy for the range of values within which we are statistically confident that the school's true value added score for the respective EBacc subject area lies.

Interpreting pupil group value added scores

These scores are based on a given set of pupils' results (who belong to a pupil group, for example disadvantaged pupils or a specific prior attainment band) for a particular test paper on a particular day. Confidence intervals are also calculated to give a proxy for a range of scores within which we are statistically confident that a school's pupil group value added score will fall. There are two ways in which a pupil group value added score can be compared; to the national average for **all pupils** (1,000) or the **national pupil group average**.

For an explanation of how to interpret confidence intervals, please refer back to page 6 (Interpreting School Value Added Scores) and an illustration of how to interpret pupil value added scores is also given in Annex C.

Calculating key stage 4 attainment

Qualifications included in the measures

Best 8 value added³ is based on pupils' performance capped to eight entries. The 2015 best 8 scores follow the performance tables' rules;

- only eligible qualifications are included⁴
- the size of each qualification is capped at a maximum of one GCSE per entry
- a limit of two non-GCSE qualifications that contribute towards the measure
- early entry rules⁵ apply, in which only a pupil's first entry in an EBacc subject is counted rather than their best entry

The qualifications included are also subject to usual performance tables discounting rules. Further detail is available in the Discounting and Early Entry Guidance on www.gov.uk

The subject value added measures include only results in qualifications that qualify for the EBacc. Further information on which qualifications count towards each subject area can be found in the English Baccalaureate List of Qualifications on www.gov.uk

Key stage 4 point scores

A pupil's performance in their best 8 qualifications (plus English and mathematics bonus) is expressed as a point score with a maximum of 580 points available. Subject point scores are as shown in table 1 overleaf.

³ Best 8 value added score is based on a pupil's best 8 qualifications once early entry rules have been applied.

⁴ Further information on qualifications that are included in the 2015 tables can be found on www.gov.uk

⁵ Further information on early entry rules can be found in the Early Entry Guidance on www.gov.uk

Qualification	Point score
GCSE – grade A*	58
GCSE – grade A	52
GCSE – grade B	46
GCSE – grade C	40
GCSE – grade D	34
GCSE – grade E	28
GCSE – grade F	22
GCSE – grade G	16

Table 1: Qualification point scores

Source: Examination Point Score guidance

Further information on point scores can be found Examination Point Score document on www.gov.uk.

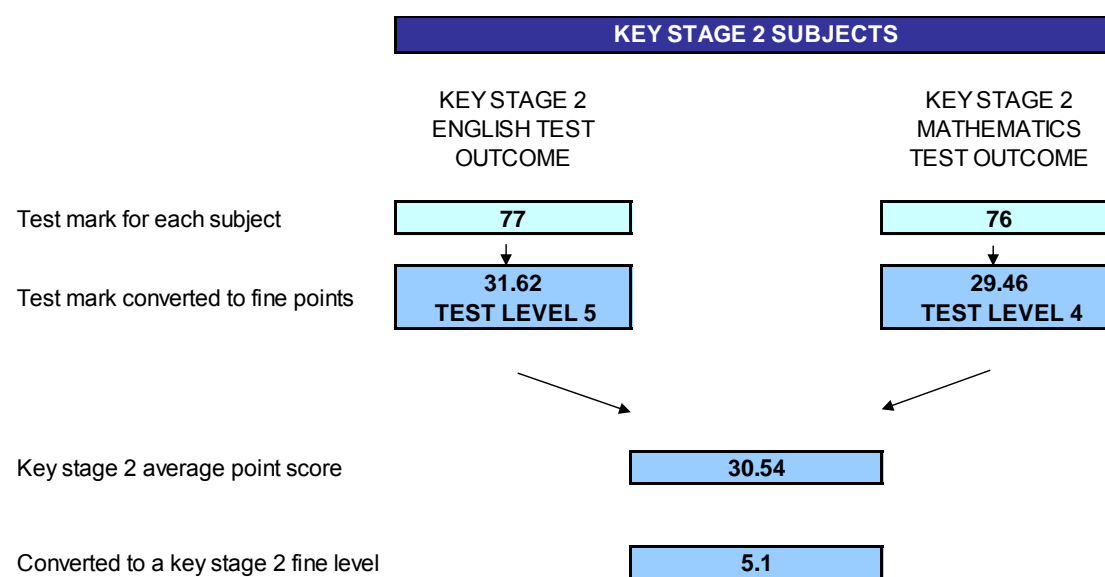
Calculating key stage 2 prior attainment

A pupil's average performance in key stage 2 English and mathematics tests are used as a baseline to compare pupil progress. The average key stage 2 point scores are converted into a key stage 2 fine level. The key stage 2 fine level is a simple conversion of dividing a pupil's average key stage 2 point score by 6 and then rounding to 1 decimal place.

Worked example

Samantha's marks in her key stage 2 tests (taken in 2010) were 77 and 76 in English and mathematics respectively.

The diagram below sets out how these are converted into an average key stage 2 fine level to be used as the prior attainment input into value added measures.



For English and mathematics assessments where a level of 3 to 5 is awarded in the test, the fine grade is calculated by:

$$\text{Basic level} + \frac{\text{actual test mark} - \text{bottom of level threshold}}{\text{top of level threshold} - \text{bottom of level threshold} + 1}$$

Using the English test mark above, 77 is a level 5 as it is between 68 and 100 which were the level 5 thresholds for 2010. The fine grade is therefore calculated as follows:

$$5 + \frac{77 - 68}{100 - 68 + 1} = 5.27$$

The fine points are calculated by multiplying the fine grade by 6:
 $5.27 \times 6 = 31.62$.

The same calculations are applied to the mathematics test outcome and the average of the two subjects is calculated to give an average point score of 30.54. This is then converted to a fine level by dividing by 6 and rounding to 1 decimal place to give a fine level of 5.1.

Adjustments are made for pupils with incomplete test results:

- if a pupil does not have a test result in a subject then their teacher assessment level is used (see table below)
- if a pupil has a result missing in one subject, then prior attainment is calculated from the remaining subject
- if a pupil does not have a test score or teacher assessment result in any subject then they are excluded from the measure

<i>If test level =</i>		
3-5	Use pupil's fine points score	
2	If teacher assessment available, use;	Award: W = 3 Level 1 = 9 Level 2 = 15 Any higher = use pupil's fine points score A,D,F,L,P,Z = Exclude pupil
	If no teacher assessment available	Exclude Pupil
B, N	If teacher assessment available, use;	Award: W = 3 Level 1 = 9 Level 2 = 15 Any higher = 15 (capped) A,D,F,L,P,Z = Exclude pupil
	If no teacher assessment available	Exclude Pupil
A, M, Q, S, T, X	If teacher assessment available, use;	Award: W = 3 Level 1 = 9 Level 2 = 15 Level 3 = 21 Level 4 = 27 Level 5 = 33 Any higher = 33 (capped) A,D,F,L,P,Z = Exclude pupil
	If no teacher assessment available	Exclude Pupil

Table 2: teacher assessment adjustment

Grade codes

A – Absent

B – Working below the level of the test

D – Disapplied

F – Key stage 2 pupil not at end of key stage 2 and taking this subject in future years

L – Left

N – Not awarded a test level

M – Missing

P – Results for subject found in previous year's dataset

S – Pending maladministration

Q – Maladministration

T – Working at the level of the tests but not able to access them

W – Working towards level 1

X – Lost

Z – Ineligible

Calculating pupil value added scores

Individual pupil value added scores are calculated first before a school value added score can be produced.

The first step is to calculate a key stage 4 “estimated outcome” for all pupils that are at the end of key stage 4 in 2015.

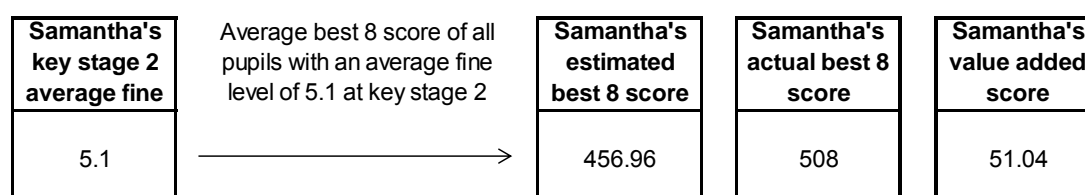
This is based on the actual key stage 4 outcomes of all pupils nationally with the same level of achievement at key stage 2 (prior attainment). A pupil’s prior attainment is defined as the average of their key stage 2 English and mathematics results, in fine levels.

A pupil’s value added score is the difference between their estimated and actual key stage 4 outcome.

Worked example

Samantha has an average key stage 2 point score of 30.54 giving a fine level of 5.1. Her best 8 plus English and maths bonus score is 508. The national average best 8 plus English and maths bonus score for pupils who share the same key stage 2 results as Samantha is 456.96.

Samantha’s value added score is the difference between her actual best 8 score and the estimated best 8 score, that is, $508 - 456.96 = 51.04$.



In addition, a key stage 2 to key stage 4 pupil level value added ready reckoner can be found on www.gov.uk. This provides the option for users to input data and test different scenarios.

Pupils in special schools

The estimated key stage 4 attainment for pupils in special schools is based on a comparison with pupils of the same prior attainment in mainstream schools.

This means that their value added scores are calculated based on averages derived from mainstream schools only.

Similarly, confidence intervals in special schools and their pupil groups are calculated using the values from the mainstream pupil population.

This approach enables special schools to compare the progress their pupils make relative to those in mainstream schools.

Pupils eligibility for inclusion in value added models

Pupils are included in the 'Best 8' value added, English Baccalaureate (EBacc) English and EBacc mathematics models if:

- their key stage 4 attainment can be matched to their attainment at key stage 2
- they have a key stage 2 average point score that is greater than zero
- they do not have a disregarded outcome in both key stage 2 tests / teacher assessments
- they attend a maintained mainstream school (including academies and city technology colleges)

Further pupil eligibility criteria exist in the case of EBacc science, humanities and languages value added measures:

- they must have completed a course of study in eligible subject(s) within each respective subject area, ie have 'entered' the subject

Note: subject entry is not a pre-requisite for inclusion in EBacc English and mathematics value added measures.

All maintained mainstream and special schools will have a value added score for all six key stage 2 to key stage 4 value added measures, provided they have at least one eligible pupil for each measure.

Calculating school value added scores

The school's value added score is the mean average of its pupils' value added scores.

Worked example continued

Samantha is one of 142 pupils in her school's key stage 4 cohort:

Pupil #	Pupil name	Value added score
1	Samantha	+51.04
2	George	-9.21
...
142	James	+31.51
Sum		+1,776.42

The school's best 8 value added score is therefore $1776.42/142 = 12.51$. For presentation purposes, this score is added to 1000 and rounded to one decimal place. As such, this school would have a best 8 value added score of **1012.5**.

A 95% confidence interval is calculated around each school value added score, defining a proxy for the range of values within which we are statistically confident that the true value of the progress score for the school lies.

The confidence interval, denoted $[LowCI_s, UppCI_s]$, is given by the formula:

$$[LowCI_s, UppCI_s] = [VA_s - CI_s, VA_s + CI_s],$$

where:

$LowCI_s$	is the lower confidence limit for the school's value added score
$UppCI_s$	is the upper confidence limit for the school's value added score
VA_s	is the school's value added score
CI_s	is the size of the confidence interval for the school's value added score

$$CI_s = 1.96 \times \frac{\sigma_N}{\sqrt{n_s}}$$

where:

1.96	is the critical value for a 95% confidence interval;
σ_N	is the standard deviation of the value added scores for all eligible pupils <u>nationally</u> ;
n_s	is the number of eligible pupils that belong to the school

The national average value added score of all maintained mainstream school scores will be 0:

- when a school has their lower confidence interval limit higher than 1,000 ($LowCI_s > 1,000$), the school's value added score is above average and the result is statistically significant
- when a school has their upper confidence interval limit lower than 1,000 ($UppCI_s < 1,000$), the school's value added score is below average and the result is statistically significant
- when the confidence interval spans 1,000 ($LowCI_s < 0 < UppCI_s$), we cannot say with confidence whether the school's value added score is above or below average, and say the result is not statistically significant

Worked example continued

We can calculate the size of the confidence interval for the school's best 8 value added score using CI_s :

$$CI_s = 1.96 \times \frac{\sigma_N}{\sqrt{n_s}} = 1.96 \times \frac{74.28}{\sqrt{142}} = 1.96 \times 6.2334 = 12.22$$

We derive the confidence interval for the school's best 8 value added score:

$$= [1012.51 - 12.22, 1012.51 + 12.22] = [1000.3, 1024.7]$$

Hence, as $LowCI_s > 1,000$ we can say with confidence that this school's 'Best 8' value added score is above average and is statistically significant.

Calculating pupil group value added scores

The value added score for a pupil group (eg disadvantaged pupils) in a school is calculated as the average value added score of all pupils that belong to that group in the school. Similarly, the value added score for a group nationally is the average value added score of all pupils in mainstream schools that belong to that group nationally.

Worked example continued

Samantha is one of 30 'disadvantaged' pupils (defined, as pupils who are either eligible for free school meals, are children who are looked after or who have been adopted from care) among the 142 pupils in her school's key stage 4 cohort, who gain a range of 'best 8' value added scores:

Disadvantaged pupil #	Disadvantaged pupil name	Value added score
1	Samantha	+51.04
2	George	-9.21
to	to	to
30	Alison	+12.16
Sum		347.41

The disadvantage pupil group value added score for the school is therefore $347.41/30 = 11.580$. For presentation purposes, this score is added to 1,000 and rounded to one decimal place. As such, this school would have a value added score of **1011.6** for its disadvantaged pupils.

More generally, the pupil group key stage 2 to key stage 4 value added score for any school, VA_g , is given by:

$$VA_g = 1000 + \overline{VA}_{pg},$$

where:

\overline{VA}_{pg}	is the average value added score for all eligible pupils that belong to the pupil group within the school, given by:
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$$\overline{VA}_{pg} = \frac{\sum_{p=1}^{n_{pg}} VA_p}{n_{pg}},$$

where:

n_{pg}	is the number of eligible pupils that belong to the pupil group within the school
$\sum_{p=1}^{n_{pg}} VA_p$	is the sum of the value added scores of eligible pupils that belong to the pupil group within the school

We calculate the disadvantaged pupil group value added score for the school, VA_g , by calculating the average value added score of the disadvantaged pupils within the school, as follows:

$$\begin{aligned} VA_g &= 1000 + \overline{VA}_{pg} = 1000 + \frac{\sum_{p=1}^{n_{pg}} VA_p}{n_{pg}} \\ &= 1000 + \frac{(51.04 - 9.21 + \dots + 12.16)}{30} = 1000 + \frac{347.41}{30} = 1011.580 \text{ (to 3 d.p.)} \end{aligned}$$

Note: We would publish this score as 1011.6, but retain the decimal places for this example for illustrative purposes for the confidence interval calculation.

Pupil group confidence intervals

Pupil group confidence intervals can be calculated in the same way as those around school value added measures. For example if looking at disadvantaged pupils you would replace n_s with the number of disadvantaged pupils within the school. The national standard deviation is still used.

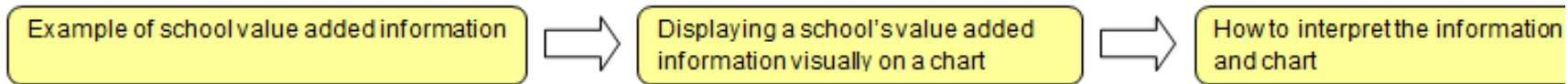
Annex A – 2015 amended attainment estimates

The estimated attainment score is the average score of all pupils nationally with the same prior attainment at key stage 2. The following table shows the key stage 4 estimates for each key stage 2 average fine level, based on the 2015 amended data.

Key stage 2 average fine level	Best 8 plus E&M bonus estimate	EBacc English estimate	EBacc maths estimate	EBacc science estimate ⁶	EBacc humanities estimate ⁶	EBacc languages estimate ⁶
<=1.5	130.74	14.81	8.88	24.47	21.34	39.59
1.6 – 2.0	175.55	20.15	12.43	25.41	20.50	38.01
2.1 - 2.5	192.37	23.21	13.52	26.34	21.22	37.29
2.6 - 2.8	204.35	24.70	15.31	25.15	19.41	33.93
2.9	218.15	25.55	17.59	25.58	20.62	32.79
3.0	228.33	26.75	18.42	27.60	22.94	35.75
3.1	234.12	26.94	19.75	26.99	22.40	32.63
3.2	239.14	27.82	20.14	27.29	22.46	32.79
3.3	252.59	28.59	21.95	29.02	23.19	33.72
3.4	264.63	29.65	23.60	29.48	24.67	32.88
3.5	270.06	30.14	24.27	30.43	25.40	34.27
3.6	283.25	31.14	26.21	31.05	26.16	33.44
3.7	296.66	32.21	27.94	32.00	27.61	33.73
3.8	305.78	32.91	29.31	32.71	28.71	34.16
3.9	317.18	33.72	30.81	33.39	29.40	34.04
4.0	324.74	34.28	31.46	34.23	30.46	34.98
4.1	338.99	35.22	33.53	35.14	31.76	34.86
4.2	350.35	36.24	34.71	35.83	32.76	35.18
4.3	361.66	37.11	35.96	36.71	34.00	35.70
4.4	372.59	37.95	37.09	37.59	35.18	36.29
4.5	380.64	38.63	37.74	38.37	36.23	37.23
4.6	395.74	39.87	39.38	39.23	37.73	37.51
4.7	407.97	40.88	40.46	40.34	39.27	38.50
4.8	419.53	41.78	41.73	41.34	40.56	39.29
4.9	432.49	42.89	42.98	42.45	41.97	40.22
5.0	439.16	43.31	43.84	43.22	42.80	41.07
5.1	456.96	44.80	45.91	44.88	44.78	42.35
5.2	469.81	45.84	47.33	46.20	46.18	43.46
5.3	483.88	46.92	49.03	47.63	47.68	44.89
5.4	498.09	48.03	50.80	49.22	49.22	46.39
5.5	494.52	48.05	49.98	48.82	48.89	46.65
>=5.6	536.90	51.88	54.60	53.43	53.29	51.41
Standard Deviation	74.28	8.14	8.54	6.46	9.08	8.33

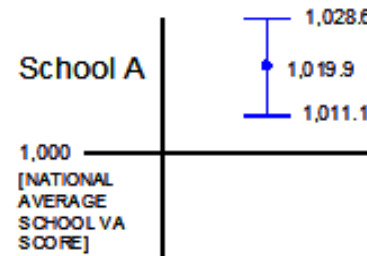
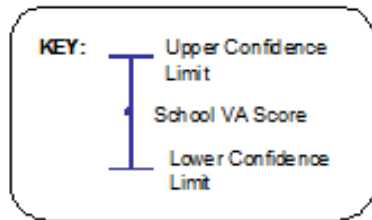
⁶ There is some volatility in the lowest prior attainment bands for the science, humanities and languages value added models, this is due in part to a low number of pupils and is consistent with previous year's models.

Annex B – Interpreting school value added scores



VA measure based on progress between Key Stage 2 and Key Stage 4
 Limit of Key Stage 2 to 4 VA Confidence intervals
 (centred around 1,000)

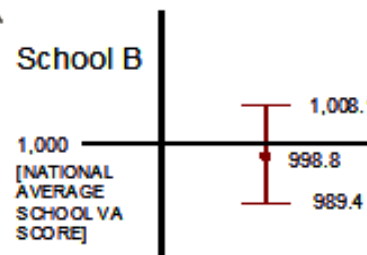
Institution Name	Upper	Lower
School A	1,028.6	1,011.1
School B	1,008.1	989.4
School C	995.4	976.4



School A's VA score is above the national average and this is statistically significant

This is because the whole range of the confidence interval is above 1,000

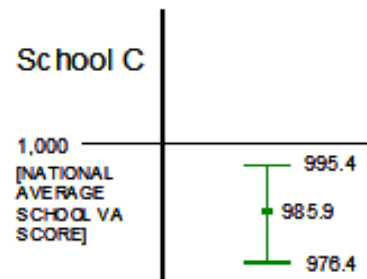
This tells us that the pupils in this school make more progress than average



School B's VA score is not significantly different from the national average

This is because the range of the confidence interval straddles the national average of 1,000

This tells us that the pupils in this school make progress comparable with the average



School C's VA score is below the national average and this is statistically significant

This is because the whole range of the confidence interval is below 1,000

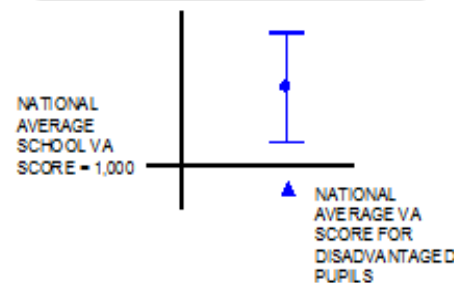
This tells us that the pupils in this school make less progress than average

Annex C – Interpreting school value added scores for pupil groups – disadvantaged pupils

Example of a school's VA Information from performance tables for disadvantaged pupils

Disadvantaged Pupils	
Best 8 VA measure - disadvantaged pupils	1004.0
Best 8 VA lower 95% confidence limit for disadvantaged pupils	1002.2
Best 8 VA upper 95% confidence limit for disadvantaged pupils	1005.8

Displaying a school's VA Information for disadvantaged pupils visually on a chart



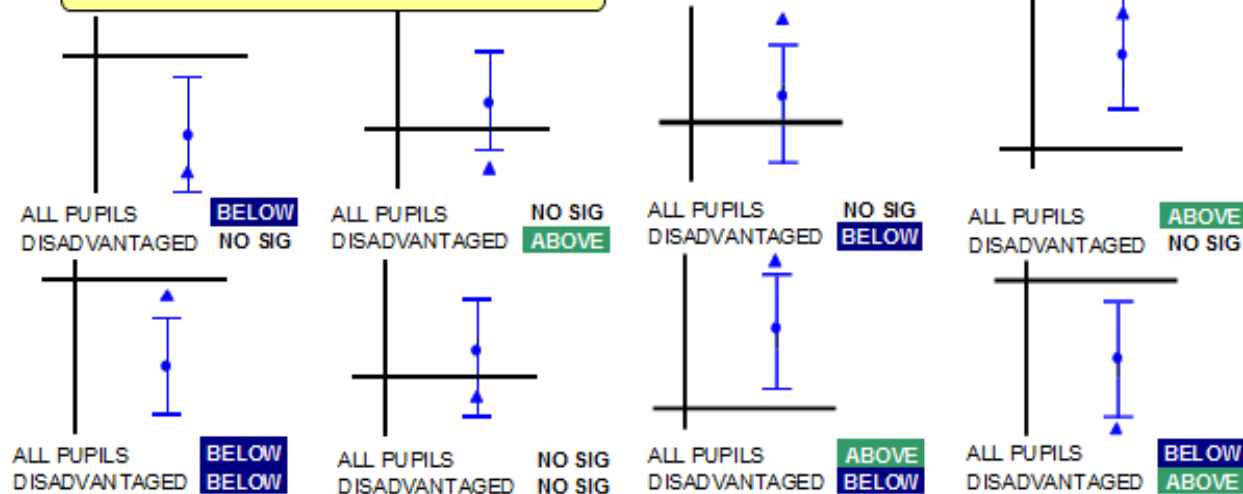
How to interpret the information and chart

The VA score for disadvantaged pupils is **above** the national average for all pupils and the national average for disadvantaged pupils and both results are statistically significant.

This is because the whole range of the confidence interval is above 1,000 and the national average for disadvantaged pupils.

This tells us that disadvantaged pupils in this school make **more progress than average** for all pupils and disadvantaged pupils nationally

Other examples of possible outcomes



KEY:

- upper confidence limit
- school VA score
- lower confidence limit
- ▲ national average VA score for disadvantaged pupils

NO SIG not significantly different

ABOVE above average and this is statistically significant

BELOW below average and this is statistically significant

Note: VA scores are also available for non-disadvantaged pupils and low, middle and high attainers



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