

LEADING ON FINANCE

Equation of life

The aim is to have as few numbers as possible which do two things. These things are

- To link together in a simple way that summarises the finances and the curriculum so it is possible to see how changing one number affects the others and to what extent.
- To allow comparison between different schools and from year to year in any one school.

There is a further aim which is to provide a simple relationship with as few numbers as possible that allows a school leader to make rapid 'rule of thumb' estimates as situations change and develop and as new plans are made.

Part One

Comparing finances

Here is the raw data for two schools that have similar age ranges, levels of deprivation and sparsity but are of different sizes. These estimates for the same academic year and not for a financial year .

Quantity	School A Value	School B Value
Total available revenue excluding any carry forward or deficit from previous years	£6,250,000	£3,900,000
September pupil roll	1250	750
Estimated expenditure on all essential non teacher costs	£2,500,000	1,800,000
Estimated average teacher cost	£50,000	£52,000

The estimate for the average teacher cost has to come from a previous year's data with a bit of guesswork and estimation built in. For example

An example of an estimation based on a previous year where the data is known for certain for school A in the table above.

Quantity/comment	Value
Previous year FTE total for all staff paid as teachers	73.5 FTE
Total salary plus on costs for this number of teachers	£3,588,858
Average teacher cost	£48,828
Best guess at percentage change in average teacher cost as a result of pay awards plus incremental drift and management structure changes	Increase of 2.4%
Estimate of new average teacher cost (old average increased by percentage on previous line)	£50,000

It might be necessary to model the possible change in detail using a full staff list and making best guesses at probable changes. Where overall staff structure and numbers are not expected to change the modelling and estimation may be much simpler.

The values in the first table allow each school can calculate the number of FTE teachers it can afford to employ for an in year balanced budget.

This is done directly by subtracting the estimated expenditure on all non-teacher costs from the total revenue and then dividing the answer by the estimated average teacher cost. This table repeats the first table and adds that line. The calculated line is shown with shading. Unshaded lines are used for data.



Quantity	School A Value	School B Value
Total available revenue excluding any carry forward or deficit from previous years	£6,250,000	£3,900,000
September pupil roll	1250	750
Estimated expenditure on all essential non teacher costs	£2,500,000	1,800,000
Estimated average teacher cost	£50,000	£52,000
Affordable FTE teachers in an in year balanced budget. Rounded down to the nearest 0.1 FTE	75.0 FTE	40.3 FTE

Whilst the method shown in the table above is perfectly sound and simple it does not allow for fair comparison either between schools or from year to year in the same school. It also uses numbers with many digits. These can be difficult to read and to discuss in a strategic manner.

The raw data shown on the first four rows of the table can be converted into a different form as shown below. Again, calculated lines are shown with shading.

Quantity	School A Value	School B Value
Total available revenue per pupil excluding any carry forward or deficit from previous years	£5,000	£5,200
Proportion of revenue available for teacher cost in a balanced budget shown to two decimal places	0.60	0.54
Estimated average teacher cost	£50,000	£52,000
Affordable Pupil to teacher ratio (PTR). Rounded down to the nearest 0.1	16.7	18.5

We can now see a clear comparison between the two schools.

A high PTR value means the school will have fewer teachers in relation to the number of pupils than a school with a lower PTR value. In the table above the PTR values mean that the curriculum offer in School B will operate with a larger size of teaching groups on average than that in school A or that the workload of staff will be higher to compensate or some combination of both.

The key underlying factor is the expenditure on everything except for teachers (54% of revenue in school B rather than 60% of revenue in school A). These figures are not judgemental. The situation in school B may be exactly what is both wanted and required. What the numbers show is the difference and what the basic nature of the difference is. It is for school leadership to take a view as to whether or not that is satisfactory and what, if anything, to do about it.

The key statistic in the table above is the PTR. This is calculated from the other quantities by multiplying the revenue per pupil by the proportion of revenue available for teacher cost and then dividing the answer into the average teacher cost. The use of spreadsheets has led to an explosion in the data and statistics used to compare schools. The relevant dashboard¹ for school self-assessment has sixteen data elements in total across the school spending and school characteristic sections. PTR is just one of these. The simple bottom line is 'Is a school operating at a PTR it can afford and does that allow for suitable and sufficient curriculum provision? On the relevant dashboard all the data lines whilst being supportive of a detailed analysis and a view as to what constitutes a similar school they are nevertheless secondary to the basic question. It should be noted that the 'Equation of life' as discussed in this paper and on the webinar has been discussed in detail on several occasions since its first use by ASCL with officials in the DfE and has informed much of the thinking behind the relevant dashboard.

If the calculation in the last table is written as an equation then it is easier to see how the variables affect the PTR value.

$$PTR = \frac{\text{Average teacher cost}}{\text{Revenue per pupil} \times \text{proportion of revenue available for teacher cost}}$$

A the PTR will be higher if either the revenue per pupil falls or the proportion of revenue available for teachers falls or if the average teacher cost increases assuming other variables remain constant. If the revenue per pupil falls and the proportion of revenue available for teacher costs rises so the product of these two remains the same then the PTR remains the same if the average teacher cost does not change.

It is simple to set up a spreadsheet to show what the impact on PTR is of changing any of the three variables on the right hand side of the equation. An example of such a spreadsheet is included in the workbook for webinars two and three in this series.

This equation is the first half of the equation of life!



The bottom line is simple; this equation made from variables that can be benchmarked gives the PTR the school can afford. The critical question is how does that compare with the PTR the school thinks it needs to operate the curriculum? In a balanced in year budget the two values for PTR must be the same. The PTR value required by a curriculum plan is covered in the next section.

Part Two

Comparing curriculum cost

A school can translate the cost of its curriculum into pounds. Impressive as this can be it is usually less informative than it appears and is subject to a lot of definition of terms such as what counts towards the cost of a 'lesson'. This makes fair, useful and informative comparisons difficult and sometimes meaningless. It can also lead to a clutter of data and information that only bogs down meaningful discussion. As T.S. Eliot so accurately pointed out in *Choruses* from "The Rock" (1934) lines 15 and 16;

Where is the wisdom we have lost in knowledge?

Where is the knowledge we have lost in information?

The currency of the curriculum is not the pound coin but the teacher period. One teacher working in a teaching context (usually in charge of a class but sometimes in a team teaching or planned intervention situation) for one period in the timetable cycle is called 'one teacher period'.

In primary schools the 'cycle' is frequently less apparent than it is in secondary schools because primary schools do not usually divide the day into a fixed number of lessons of equal length with different teachers taking groups of pupils for different subjects. The 'period' is just a unit of time for measuring time in the curriculum for such things as teacher time, room use and curriculum content delivery. The cycle is the total period of time after which the curriculum repeats. In secondary schools this is commonly either once every calendar week or once every fortnight although several other variations also exist in different schools. In most primary schools it is simplest to think in terms of a one calendar week cycle with one period being half a day. This is because in general the work of teachers can usually be summarised in a number of half days. For example a common time allocation for a classroom teacher might be nine half days of teaching and one half day of PPA time. A primary headteacher might do not classroom teaching other than in an emergency situation and hence has a timetable made up of ten half days of management time. If the half day as a period which makes the cycle 10 periods long in a primary school is not sufficiently granular then quarter days making up a 20 period cycle or even a number of hours can be used.

The total amount of teacher time measured in teacher periods is one way of representing the size and hence the cost of the curriculum. Unfortunately as with the initial finance data the simple teacher period (tp) total does not provide a fair comparison either between schools or between years in the same school due to differences in pupil roll and also in what constitutes a 'period' in the timetable cycle. In terms of raw data this is shown in the table below again for schools A and B.

Quantity	School A Value	School B Value
Length of timetable cycle	50	30
September pupil roll	1250	750
Total of all teacher periods on the curriculum plan including intervention activity, team teaching and learning support	2919	985

Note that the cycle in school A is a two week cycle and the cycle in school B is a one week cycle.

A fair comparison between the two schools can be made by converting this data into a value for the Pupil to Teacher ratio in the curriculum. For historic reasons this is known as the 'Average Class Size'. For the remainder of this document the term Average Class Size will be used to represent the pupil to teacher ratio in the curriculum. Please note that this is not necessarily the average size of a teaching group as explained in the appendix! This is particularly the case in post 16 where pupils have non-contact time for private study.

In terms of the table above if you divide the total teacher periods (line 3) by the cycle length (line 1) you get the average number of teacher in teaching contact on any one period of the cycle taken as an average across the whole cycle. The result is

Quantity	School A Value	School B Value
Average number of teachers teaching on any one period	58.38	32.83

(figures shown to two decimal places)



This is moving towards a fairer comparison but does not take account of the school roll numbers.

To find the Average Class Size (pupil to teacher ratio in the curriculum) these calculated values are divided into the school roll.

The result is

Quantity	School A Value	School B Value
Average Class Size (Pupil to teacher ratio in the curriculum)	21.41	22.84

These values are comparable between different school and between different years in the same school. In this case school B is operating a curriculum with fewer teachers per pupil than is the case in school A. whether this is a good thing or a bad thing or neither of those is in no way indicated by the numbers. It might however be interesting if the progress of pupils in school B is significantly better than those in School A and all other relevant factors are considered to be equal or at least very similar.

The true value of this statistic comes into play when one takes into account another statistic called the 'contact ratio'

An individual teacher does not teach pupils on every period of the timetable cycle. This non-contact time does not contribute to the tp value that is part of the Average Class Size. A headteacher might make no tp contribution to the curriculum and have a personal timetable that of management time on every period. Other senior leadership team (SLT) members and teachers with management responsibilities will probably have different amounts of management time on their timetables and if they do also teach on some periods they will have some PPA (planning preparation and assessment) time.

In this silly example at the Disney Cartoon School the head teacher is Snow White, the rest of the SLT are Doc and Grumpy, the teachers with management responsibility are Happy, Sleepy, Bashful, Sneezy and Dopey. The rest of the staff are not shown in the table by name and are referred to below as 'classroom teachers' Classroom teachers all have a full teaching load with part time staff having an appropriate pro rata load. If the SLT and management responsibility all count as 1 FTE then in detail the teaching contributions, management and PPA cycle periods might look like this.

Period allocations in a 25 period cycle.

Name	FTE	tp load	Management	PPA
Snow white	1	0	25	0
Doc	1	8	16	1
Grumpy	1	8	16	1
Happy	1	18	5	2
Sleepy	1	18	5	2
Bashful	1	18	5	2
Sneezy	1	20	3	2
Dopey	1	20	3	2
Totals	8	110	78	12

Imagine the Disney Cartoon School has a total of 28 FTE teachers. If all the teachers except the classroom teachers are shown in the table above there must be 20 FTE teachers with a full teaching load. If the policy of the school is for classroom teachers to have a teaching load of 22 out of 25 with 3 periods of PPA then 20 FTE classroom teachers provide 440 tp, a summary of the situation is shown in the next table. Note that if the total number of classroom teachers contains a combination of part time teachers there may be a slight difference between the eventual actual total tp and the theoretical 440tp value of one or two tp.

Teacher category	FTE	Total tp load
SLT and Management Teachers	8	110
Classroom teachers	20	440
Totals	28	550



This means that the 28 FTE teachers provide 550tp between them, an average load of 19.64 (shown to two decimal places) each. If you divide the unrounded value of the average load by the length of the cycle you get 0.786 (shown to three decimal places). This fraction is the proportion of the cycle that teachers spend teaching as an average across all teachers. This decimal fraction is called the contact ratio.

The contact ratio can be used as a fair comparison between schools and from year to year in the same school as it takes account of differences in school size and cycle length.

An example with schools A and B building on the tables above.

Quantity	School A Value	School B Value
Length of timetable cycle	50	30
September pupil roll	1250	750
Total of all teacher periods on the curriculum plan including intervention activity, team teaching and learning support	2919	985
FTE teacher total in SLT and with management time	45	26
Total tp contribution from SLT and managers	1603	569
Balance of tp required from classroom teachers	1316	416
Teaching load for a classroom teacher	44	26
Number of classroom teachers required	29.9	16
Total FTE required	74.9	42
Average teaching load across all teachers	38.97	23.45
Contact ratio	0.779	0.782
Average Class Size (PTR in the curriculum)	21.41	22.84

The penultimate line in the table shows that the balance for teachers between teaching and non-contact time (PPA and management time) is approximately similar in the two schools despite vast differences in cycle length and pupil roll. The final line compares the pupil to teacher ratio in the curriculum and hence teaching contact timetable in a fair manner.

It must be noted that the table above is a summary of each school form a purely curriculum point of view. That means that the curriculum planners are looking to ask the school to employ the number of FTE teachers shown in the table but that this is happening with no reference to the finances. Once we apply the equation of life, as outlined at the end of the next section the table above will be cast into stark reality in one of the schools!

In some schools it may be more convenient to have a policy decision about what the overall contact ratio will be and then adjust management and possibly PPA time as necessary on a year to year basis. The alternative approach of defining the management periods and the teaching load for classroom teachers is taken in this paper. There is no recommended method it is up to a school to decide the best approach to suit its own circumstances. In any case if all classroom staff teach at a maximum load with the minimum possible PPA allocation then the only flexibility in the contact ratio comes from an adjustment of management time and similar non-contact time allocation. The contact ratio varies naturally as the proportion of staff on full teaching loads and those with management time varies from year to year. The second part of the equation of life gives the PTR required for the curriculum plan. The Average class size for the curriculum plan is calculated as indicated above or in the case of a school using NOVA-T6 for planning purposes noted from the Analysis² screen and this is multiplied by the contact ratio to give the PTR the school needs for its curriculum. i.e.

$$PTR \text{ required for curriculum} = \text{contact ratio} \times \text{Average class size}$$

In a balanced budget the PTR the school can afford and the PTR required for the curriculum must be the same. This gives us a very powerful relationship all in terms that can be compared from school to school and also in the same school from year to year.

Using symbols for the different terms we have

If

² The Analysis in NOVA-T6 works in class periods and not teacher periods. It is possible to use the software so that these things read the same but it is also possible to use it so that they differ. Care must be taken by studying the manual to ensure that the overall Average Class Size displayed on the Analysis screen at the bottom right corner of the screen when 'Class Size' is selected is in fact the pupil to teacher ratio in the curriculum. If in doubt use the manual calculation approach described earlier in this document.



Average teacher cost is represented by S

Revenue per pupil is represented by I

Proportion of expenditure available for teacher cost is represented by p

Contact ratio is represented by c

Average Class Size (the pupil to teacher ratio in the curriculum) is represented by A

and omitting multiplication signs (i.e. lp means I multiplied by p)

So in a balanced budget the relationship is

$$\frac{S}{lp} = cA$$

For the purposes of this webinar it is simpler to split the equation as follows

$$\text{Affordable PTR} = \frac{S}{lp}$$

$$\text{Desirable Curriculum PTR} = cA$$

The bottom line on these equations is found by calculating both PTR values.

There are three possible outcomes with reference to the Dickens character Mr Micawber in David Copperfield.

Possibility	Financial Consequence	Wilkins Micawber's view
Finance PTR greater than Curriculum PTR	Deficit	Misery
Finance PTR equal to Curriculum PTR	Balance	Happiness (just)
Finance PTR less than Curriculum PTR	Surplus	Happiness

Applying this to the two schools used above gives.

(The proportion of revenue available for teaching in a balanced budget is referred to as 'Proportion in this table).

Quantity	School A	School B
Average teacher cost	£50,000	£52,000
Per pupil revenue	£5,000	£5,200
Proportion	0.6	0.54
Finance PTR	16.7	18.5
Average Class Size	21.41	22.84
Contact ratio	0.779	0.782
Curriculum PTR	16.7	17.9
Comment	The curriculum plan is in line with the financial situation. Any slight difference in PTR values is in the second place of decimals and should be simple to reconcile with small adjustments.	The difference in PTR values is equivalent to an in year deficit of around £70,000



The equivalent financial difference in PTR values is simple to calculate in a spreadsheet. A formula that can be used is to calculate the difference in the PTR values divided by the product of the PTR values and the multiply the result by the product of the pupil roll and the average teacher cost.

Using the equation

Repeating the two halves using the symbols above we have

$$\text{Affordable PTR} = \frac{S}{lp}$$

$$\text{Desirable Curriculum PTR} = cA$$

A school can use benchmarking data from the DfE dashboard tools³ and the GOV.UK website and discussions with other similar schools to decide if any of the terms on the right hand side of the two equations are either unusually high or unusually low with respect to similar schools and what, if anything could or should be done about that.

If in any one year the Affordable PTR exceeds the desirable PTR then the terms in the equation indicate the relevant leavers.

To decrease the affordable PTR then consider any combination of the following

- A decrease in the average teacher cost
- An increase in available revenue per pupil
- An increase in the proportion of revenue available for teacher cost.

Reversing the increases or decreases will increase the affordable PTR

To increase the Desirable Curriculum PTR then consider any combination of

- Increasing the contact ratio
- Increasing the average class size

Again changing the increase to decrease will decrease the Desirable Curriculum PTR

Rule of thumb estimates are easy to make once a school leader is fully aware of the current values in the equation and familiar with the extent to which a decision such as a staff pay award might change any relevant variable. The ability to use the equation in this manner only comes with familiarity and practice.

The difference in PTR values between the curriculum need and the financially affordable PTR can be converted into the resulting in year deficit or surplus. This is done in the spreadsheet for webinars two and three.

There are many other ways in which the equation of life can be used and some of these are discussed in articles available on the GOV.UK and ASCL websites. Alternatively interested ASCL members can email Sam Ellis at samelliscottingham@gmail.com

