

## DHSLCalc.xls

### What is it?

It's an Excel file that enables you to calculate easily how seats would be allocated to parties, given the distribution of votes among them, according to two common seat allocation formulae: the D'Hondt method and the Sainte-Laguë method.

It also works out the percentage votes and percentage seats of each party, along with the values of 3 indices that are widely used in the analysis of elections:

Least squares index (measure of disproportionality, i.e. the disparity between vote shares and seat shares);

Effective number of elective parties (measure of vote fragmentation);

Effective number of legislative parties (measure of seat fragmentation).

### How does it work?

(i) Download the file DHSLCalc.xls. It's a standard MS Excel file. It can be found on this site:

[www.tcd.ie/Political\\_Science/Staff/michael\\_gallagher/EISystems/index.php](http://www.tcd.ie/Political_Science/Staff/michael_gallagher/EISystems/index.php).

(ii) For the election you want to analyse, enter the votes received by each party along with the total number of seats.

(iii) manipulate the quota so as to produce the right outcome.

The programme then tells you:

how many seats each party wins under the D'Hondt (or Sainte-Laguë) formula;

% votes and % seats for each party;

value of least squares index (LSq);

effective number of vote-winning (Eff no  $P_v$ ) and seat-winning (Eff no  $P_s$ ) parties.

### Describe in detail what I need to do

The file contains 11 templates into which the details of an election can be entered.

The first has already been filled in as an example, with the seat and vote values of the parties in the 20-seat Helsinki constituency at the 1999 election in Finland.

The first blank template begins in row 30 (cell A30 contains the phrase 'D'Hondt allocation').

First, enter the total number of votes in cell E32, and the votes for each party in cells F32, G32 etc.

Second, enter the total number of seats in cell E34.

Then, examine the 'check' cell; C32 in the first blank template. It should give a value of zero; if not, that means that the numbers of votes you have entered for the parties don't add up to the number you've entered for the total votes. Either there is an error in the data or you have made a mistake in entering it. (However, very minor errors – for example, if you are entering percentages and due to rounding the total adds to 99.9 rather than to 100.0 – are unlikely to make any difference to the seat distribution or the value of the indices that is worth being concerned about.)

If there is no problem here: now comes the complicated part. Your aim is to find a quota of the right size to allocate exactly the specified number of seats. You enter the value of the quota in cell B32, under the cell reading 'Try quota'.

### **How do I know what value of quota to enter?**

A good first estimate of the correct D'Hondt quota is the Droop quota. Cell A32 (under 'Droop quota') gives the value of this (it is based on the number of votes, divided by the number of seats plus 1). So, in the cell underneath 'Try quota' enter a number somewhere in the vicinity of the Droop quota.

When allocating seats by the Sainte-Laguë method, the Hare quota (the number of votes divided by the number of seats) is a good first estimate. Cell A45 (under 'Hare quota') gives this value.

### **Then what?**

Your aim is to find a quota that allocates exactly the right number of seats. So look at cell C34, which is two cells to the left of the number of seats (E34). C34 tells you how many seats would be allocated by the quota at its current value. Ideally, it should contain the same number as E34.

If it doesn't, you need to adjust the quota either upward or downward until it does. If the number of seats shown in C34 is below the correct number, that means your trial quota is too high and you need to reduce it. If it's above the correct number, your trial quota is too low and you need to increase it.

Whether you need to adjust the quota by a few votes, a few hundred votes or a few thousand votes obviously depends on how many votes were cast in total and on how far the initial number of seats is from the correct number. By trial and error you will soon become familiar with the scale of adjustment needed.

Usually a range of numbers satisfy the requirements; you are not searching for a unique number. In the 1999 election in the Helsinki constituency shown as an example in the Excel file, any number in the range 11,481–12,349 inclusive allocated precisely the required 20 seats under the D'Hondt method; any number in the range 14,655–14,739 inclusive allocated precisely the required 20 seats under the Sainte-Laguë method. In the unlikely event of two or more parties being neck and neck for the final seat, with one number allocating too few seats and the number 1 smaller allocating too many, you may have to use decimal values.

### **Once I've got the quota right, what does it tell me?**

It tells you how many seats each party wins, as well as the percentage vote and percentage seats of each party. In the bottom left-hand corner of the template, in bold, it gives the value of three indices: disproportionality (LSq, least squares index), fragmentation of votes (Eff Nv, effective number of elective parties), fragmentation of seats (Eff Ns, effective number of legislative parties). If you only want to know the value of these indices, then you are better off using a simpler file that can be downloaded from the same site:

[www.tcd.ie/Political\\_Science/Staff/michael\\_gallagher/EISystems/index.php](http://www.tcd.ie/Political_Science/Staff/michael_gallagher/EISystems/index.php)).

### **What else can I do with it?**

You can explore the effect of different district magnitude and different formula. In the Helsinki 1999 example shown in the Excel file, you can see that the D'Hondt and Sainte-Laguë formulae produce seat allocations that are very similar but not quite identical. The largest party (party 3) wins 7 seats under D'Hondt and 6 under Sainte-Laguë, while the small party 7 wins no seats under D'Hondt but 1 under Sainte-

Laguë. If Sainte-Laguë is used, disproportionality is lower and the fragmentation of the seats in parliament is slightly higher. So you can compare the effects of D'Hondt and Sainte-Laguë on the same set of vote shares.

You can also explore the effect of district magnitude. For example, in the Helsinki 1999 example, suppose there were only 5 seats rather than the actual 20. Now, after trial and error, you discover that a quota of 30,000 allocates all 5 seats under D'Hondt. The level of disproportionality would now be much higher (17.54) than when there were 20 seats, and the largest two parties, with 52 per cent of the votes between them, would receive 80 per cent of the seats.

### **How many parties can the file cope with?**

It's designed to deal with elections with up to 100 parties. In the unlikely event that you want to analyse an election with more than 100 parties, a basic knowledge of Excel should enable you to work out how to do this.

Of course, when there are fewer than 100 parties, you only have to enter figures for the parties that did contest the election; you don't need to fill out the rows by entering zeros under the other columns.

### **How many elections can it deal with?**

The file that you can download has 10 'blank' templates. Of course, once you have the file, you can extend the number of templates indefinitely simply by copying the template, or by 're-using' each template. But if you 'fill up' the programme that you download, you can always download it again.

### **I don't have raw vote totals, just percentages.**

No problem. Just enter the percentages in the 'votes' row. It doesn't affect the calculations at all.

### **In the data source I'm using, the votes of a lot of small parties and independents are bunched together in one bloc labelled 'Others'. Does this matter?**

Yes, it does. All PR formulae award seats to parties based on their size, and if the 'Others' bloc is treated as one bloc then it will compete for seats on the same basis as a genuine party. Consequently, you should aim for as much disaggregation as possible. The vote (and seat) total of every small party, even every independent candidate, should ideally be entered separately. That is the basis on which, in real life, seats would be allocated: it's impossible to decide how to allocate seats among parties unless you know how many votes each party has won.

However, in practice you might want to use the file to see how seats would have been awarded at an election on the basis of the national vote total. In this case, if perfect information is not available, the best option is simply not to enter the votes for aggregated 'Others'. (This might be justified if there is a legal threshold for seat qualification in operation, in which case it is quite plausible that none of the parties that is so small that it is lumped in with the rest of the others would have qualified for any seats.) The Excel file will then show how the seats would have been allocated among the larger parties.

Similarly, if there is a legal threshold for seat qualification (no party qualifies for seats unless it has received a certain percentage of the votes), then you should omit all those parties that fall below the threshold.

Note that if you do omit 'Others' and small parties then, while the seat allocation is correctly shown by the Excel file, several of the other values (% vote for each party, least squares index, effective number of legislative parties) will not be correct. To calculate these measures correctly given bunched 'Others' you should download the files 'IndicesCalc.pdf' and 'IndicesCalc.xls' from the same site:

[www.tcd.ie/Political\\_Science/Staff/michael\\_gallagher/EISystems/index.php](http://www.tcd.ie/Political_Science/Staff/michael_gallagher/EISystems/index.php)).

### **What are these formulae anyway?**

The D'Hondt method (named after Victor D'Hondt) is the most widely used PR formulae, while Sainte-Laguë (named after André Sainte-Laguë) is the fairest (in the sense of being unbiased as between larger and smaller parties). These seat allocation methods are more widely known under different names in the USA: D'Hondt is known as the Jefferson method, and Sainte-Laguë as the Webster method. Since perfect proportionality is unlikely to be attainable in practice, some party or parties must end up over-represented (gaining the benefit of the doubt, so to speak) while another or others end up under-represented. D'Hondt always gives a larger party the benefit of the doubt compared with a smaller party, and over time gives a cumulative advantage to larger parties, while Sainte-Laguë is even-handed between parties regardless of their size.

For more information about these indices, see Michael Gallagher and Paul Mitchell (eds), *The Politics of Electoral Systems* (Oxford: Oxford: Oxford University Press, paperback edition 2008), Appendix A:  
<http://ukcatalogue.oup.com/product/9780199238675.do>

### **How do they work?**

They are both usually described as 'highest average' methods. Under D'Hondt, each party's vote total is divided successively by 1, 2, 3, 4 etc to produce a succession of 'averages'. The seats are awarded sequentially. First, each party's vote total is divided by the first divisor (1) to give its initial 'average', which in this case is obviously the same as the number of votes it won. The first seat is awarded to the largest party, and its vote total is divided by the second number in the sequence (2) to give its new average. The second seat is awarded to the party whose average is now highest, and its average is divided by the next number in the sequence (3 if the largest party, having already won the first seat, now wins the second one as well, or 2 assuming another party wins the second seat). At any given point in the process, each party's 'average' equals the number of votes it won divided by 1 more than the number of seats it has so far won, and the next seat goes to the party with the highest average. The process continues until all the seats have been allocated.

The method of the Sainte-Laguë formula is similar, but now the divisors are 1, 3, 5, 7 etc. Thus the 'average' of the larger parties is reduced more rapidly than under the D'Hondt formula, and small parties have a better chance of winning seats.

### **That's fascinating, but it doesn't seem to bear any resemblance to what's going on in the Excel file**

That's because, even though D'Hondt and Sainte-Laguë are usually presented as highest average methods, they can also be regarded as special cases of 'largest remainder' methods, under which each party receives a seat for every 'quota' of votes that it possesses and any unallocated seats go to the party or parties with the largest remainders of votes.

Under archetypal largest remainder systems, the size of the quota is fixed (i.e. determined solely by the number of votes and the number of seats) and there may or may not be a need to reward some remainders. In the case of D'Hondt and Sainte-Laguë, though, the size of the quota is deliberately set to ensure that a particular rule regarding remainders will always be followed.

In the D'Hondt method, the quota is fixed at such a level that all the seats are allocated by full quotas, and therefore no remainder is ever rewarded. In practice, countries employing the D'Hondt method sometimes use this shortcut rather than taking the long route of employing divisors to allocate sequentially the first seat, then the second, and so on. Carrying out the D'Hondt allocation in this way is sometimes known as the Hagenbach–Bischoff method – but it's important to stress that it's simply another way of implementing the D'Hondt scheme, not a different formula.

In the Sainte-Laguë method, the quota is fixed at such a level that each full quota, and every remainder that amounts to half a quota or more, receives a seat.

Looking at these two formulae in that way, it is simply a matter of 'finding the right quota'. That is what the Excel file enables you to do.

### **Where can I get more information?**

You can read more about seat allocation methods in Appendix A of *The Politics of Electoral Systems*, edited by Michael Gallagher and Paul Mitchell (Oxford: Oxford University Press, paperback edition 2008). Appendix B of the same book has information on the least squares index and the effective number of parties measure.

Web site:

<http://ukcatalogue.oup.com/product/9780199238675.do>