

STV Rules for Transferring Surpluses of Votes

Briefing Note on Recommendation 14 in the Stage 1 Report on the Local Governance (Scotland) Bill prepared by the Local Government and Transport Committee

1. In its review of the Local Governance (Scotland) Bill, the Local Government and Transport Committee considered some technical issues surrounding the counting of votes (paragraphs 185 to 200), reached the following conclusions and made the following recommendation [1]:

14. The Committee—

- **Concludes that the method set out in the Bill is the most appropriate one for local government elections in Scotland at this time, given the currently available counting technology;**
- **Believes that its preferred alternative, the ‘weighted inclusive Gregory method’, is, theoretically, the most effective counting method as it ensures that the preferences expressed by all voters are counted; but notes manual counts using this system would be unrealistically time consuming; and**
- **Recommends that the ‘weighted inclusive Gregory method’ be introduced to replace the system set out in the Bill when electronic counting becomes available.**

2. In reaching these conclusions and making this recommendation, the Committee appears not to have been aware that some other, very far-reaching changes would have to be made to the counting procedure if the introduction of the ‘weighted inclusive Gregory method’ of transferring surpluses were not to produce internally inconsistent results. Specifically, when the ‘weighted inclusive Gregory method’ is used, it is necessary also to transfer surplus votes to candidates who have already been elected and then to deal with the consequential surpluses so created. Without this additional provision, the counting procedure would give internally inconsistent results. The potential for this inconsistency is absent from the (simple) ‘Gregory method’ of dealing with the transfer of surpluses. It is this method that is described in the Local Governance (Scotland) Bill as introduced.

3. From the comments in its Report, it would also appear that the Committee was not aware that there is an intentional and fundamental difference of philosophy between the concepts of representation inherent in the (simple) ‘Gregory method’ and those inherent in the ‘weighted inclusive Gregory method’. This difference has practical consequences for significant numbers of voters (see paragraphs 27, 28 below).

4. It is clear from the evidence heard by the Committee that there is considerable misunderstanding of the issues involved. This Briefing Note has been prepared in anticipation of the Stage 2 consideration of the Bill. It explains the five methods of transferring consequential surpluses currently in use in STV elections and sets out the issues relating to each.

Alternative Rules for Transferring Surplus Votes

5. Surpluses may arise in two different ways during an STV count. A surplus may be recorded at the first stage in an STV count, when the number of first preference votes credited to a candidate exceeds the quota. The procedure for dealing with such surpluses is described below, for comparison with that for consequential surpluses.

6. Surpluses may also arise at the second or a later stage of the count, when either the surplus votes of a previously elected candidate are transferred or all the votes of an excluded candidate are transferred. These surpluses are consequential on the outcome of some previous decision in the count, ie the election of a candidate or the exclusion of a candidate. The Committee's considerations relate to the disposal of these consequential surpluses.

7. There are five methods of handling the transfer of such consequential surpluses:

- random selection
- Gregory
- inclusive Gregory
- weighted inclusive Gregory
- Meek

These are explained in more detail below.

Transfers of First Preference Surpluses

8. When a candidate's first preference vote exceeds the quota, that candidate is deemed elected and the surplus of votes, in excess of the quota, is transferred. The only way this can be done without introducing an element of chance into the process, is to move every one of the transferable ballot papers to the candidates marked as the next available preferences on those ballot papers. So that only the surplus of votes is transferred, the value of each ballot paper is reduced when it is moved.

9. An older, alternative procedure is to take a number of randomly selected ballot papers, equal to the value of the surplus. No matter how this random selection is made, taking a random sample of ballot papers inevitably introduces an element of chance into the process. Procedures such as sorting the papers to the next available preferences and then randomly sampling each sorted parcel, will minimise the chance effect, but no such procedure can eliminate the element of chance. A re-count could give a different result, purely by chance.

10. No procedure involving random selection is now acceptable for public elections in the UK (though it is still used in the Republic of Ireland). Random selection was removed from the revised rules when STV was re-introduced in Northern Ireland in 1973 for both the District Council elections [2] and the Northern Ireland Assembly elections [3].

TRANSFERS OF CONSEQUENTIAL SURPLUSES

Random Selection

11. Random selection can be implemented in several different ways, but none of these will be described here. No method that would introduce chance into the procedure is now acceptable in the UK. Experience in Northern Ireland over the past

30 years has shown that a method involving fractional transfers, without random selection, is practicable for major public STV elections.

Gregory Method

12. In the (simple or classical) 'Gregory method', only the parcel of ballot papers that gave rise to the consequential surplus is scrutinised for transfer. The transfer of a consequential surplus is the completion stage of the transfer that gave rise to the surplus that is now available for transfer. Only the last parcel of papers is scrutinised for transfer to ensure consistency with the practice of passing over preferences for candidates who have already been elected. Any other treatment of the parcels of ballot papers held by the elected candidate whose consequential surplus is being transferred would produce internally inconsistent results. These are two complementary parts of the same principle and they cannot be separated.

13. If the total value of the transferable ballot papers in the last parcel is equal to or less than the surplus, the papers are transferred at their current value. If the total value of the transferable papers in the last parcel exceeds the surplus, the value of each paper is reduced on transfer. The details of these calculations are illustrated in Examples 1 and 4.

14. To ensure consistency of approach with the 'Gregory method' of transferring consequential surpluses, transfers on exclusion are handled in sub-stages when the excluded candidate has ballot papers of more than one value. The candidate's first preference ballot papers (value = 1.00 vote each) are transferred first, followed by any other papers of value = 1.00 vote and then by the papers of successive lower values. If on completion of any sub-stage, a candidate to whom some of those papers have been transferred has a quota of votes, that candidate is deemed elected and no further transfers are made to that candidate during the remaining sub-stages of that exclusion. This ensures that any surplus arising as a consequence of the exclusion consists of papers of only one value. Transferring the first preference papers separately from other papers of a value of 1 vote ensures consistency with the philosophy inherent in this method.

Inclusive Gregory Method

15. In the 'inclusive Gregory method', all the parcels of ballot papers held by the elected candidate are scrutinised for transfer. It is thus usual for the total value of the transferable papers greatly to exceed the surplus and so a fractional transfer value must be calculated. In this method, any differences in the current values of the ballot papers are ignored, and an average transfer value is calculated for all the papers. While this will reduce the vote value of some ballot papers, it will increase the vote value of other ballot papers.

16. This method is fundamentally flawed because it violates one of the principles of STV, namely, that all voters should have only one vote. No method can be recommended that arbitrarily gives some voters more than one vote and other voters less than one vote. All voters should equally have one vote. This method will not be considered further here.

Weighted Inclusive Gregory Method

17. In the 'weighted inclusive Gregory method', all the parcels of ballot papers held by the elected candidate are scrutinised for transfer, but any differences in the current values of the papers are taken fully into account when new fractional transfer values are calculated.

18. In the unlikely event that the total value of all the transferable ballot papers is equal to or less than the surplus, the papers are transferred at their current values. In the more usual situation, where the total value of the transferable papers exceeds the surplus, the value of each paper is reduced on transfer. The calculation of the new transfer values is in two parts. The proportion of the surplus to the candidate's total vote is determined first. That proportion is then applied separately to each differently valued parcel of ballot papers to give the new transfer values. The details of these calculations are illustrated in Example 2.

19. It should be noted, however, that if the 'weighted inclusive Gregory method' is implemented without some other major changes to the counting procedure, inconsistent results will be obtained. This inconsistency is illustrated by Examples 2 and 5. To remove this inconsistency it is necessary to change the rules on transfers of votes to allow transfers to be made to candidates who have already been deemed elected. Of course, additional surpluses are then created and these, in turn, must be transferred. But this is the only way that internally consistent results can be obtained. The effect of making these two changes together is illustrated by Examples 5 and 6.

20. To ensure further consistency with the 'weighted inclusive Gregory method', it is necessary also to change the way ballot papers are handled when an exclusion is made and the excluded candidate has papers of more than one value. As in the 'Gregory method', described in paragraph 13 above, the exclusion is done in sub-stages. Ballot papers of successively decreasing values are transferred in the successive sub-stages, starting with the highest value papers. The difference is that transfers must be made at all sub-stages to all non-excluded candidates, without regard to the possibility that one or more of them may have attained a quota of votes at the completion of an intermediate sub-stage. It is also inappropriate and unnecessary to handle first preference ballot papers separate from any other papers with a value of 1 vote. Any surplus arising as a consequence of an exclusion by this procedure may consist of papers of more than one value. That does not, however, create any problem because the consequential surplus will be handled by the 'weighted inclusive Gregory method'.

Meek Method

21. The Meek STV rules implement both the 'weighted inclusive Gregory method' of handling consequential surpluses and the transfer of votes to candidates who have already been deemed elected. This method thus produces internally consistent results, as illustrated by Examples 3 and 6. The Meek rules also implement the exclusion procedure described in paragraph 20 above, to ensure complete consistency with the approach taken to handling consequential surpluses.

22. In addition, the Meek rules include a number of other, unrelated changes to the rules commonly used for manual counts: specifically, the reduction of the quota whenever more non-transferable votes are encountered and a consequential recount *ab initio*. For these reasons, the Meek method will not be considered further here.

Evaluation of Outcomes

23. In some circumstances the (simple) 'Gregory method' and the 'weighted inclusive Gregory method' (with transfers to already elected candidates) may give slightly different results. An analysis of the voting patterns in the STV elections for the Dáil Éireann has indicated that this difference might affect two candidates in every 100 elected [4]. The difference usually, but not always, occurs in filling the last place.

24. Given that such differences can occur, there is understandably a concern to determine which is "correct" or "better". There is no independent measure available to determine which of the results is "the more representative" of the voters' wishes when the two methods of counting have given different results. Both are equally valid; both are equally "correct". There is, however, a fundamental difference in the philosophy of representation inherent in these two methods and in the results they produce.

25. In the first approach, quota groups of voters (NB "voters") are defined as exclusively and discretely as possible, and a vote is transferred only when it is no longer needed to help elect the voter's highest placed preference. The vote is to remain as intact as possible with the voter's highest placed preference for as long as possible. The intention here is to maximise the diversity within the representation by minimising the 'dilution' of any individual voter's effect that could occur by taking other voters' preferences into account when transfers have to be made. This intent is implemented through the combination of the (simple) 'Gregory method', never transferring votes to candidates who are already elected, making exclusion transfers in sub-stages, and by transferring first preference papers separately in the first sub-stage of an exclusion.

26. In the second approach, quota groups of voters are defined as inclusively and comprehensively as possible, and the preferences of all possible voters are taken into account whenever a transfer has to be made. The intention here is to obtain a result that is "the most representative possible" by making the maximum use of the preferences of the greatest possible number of voters on every possible occasion. This intent is implemented through the combination of the 'weighted inclusive Gregory method', always transferring votes to candidates who are already elected, making exclusions (in effect) in one stage, and by not transferring first preference papers separately when an exclusion is made.

27. Although this difference is essentially one of philosophy, and therefore not susceptible to any simple arithmetic evaluation, it does have one consequence that may affect significant numbers of voters, specifically, those who (sincerely) mark only a small numbers of preferences. The first (exclusive) approach minimises the potential 'dilution' of the wishes of such voters because their ballot papers and their votes will stick with one of their high placed preferences if at all possible. The second (inclusive) approach will disadvantage these voters because the lack of lower preferences on their papers will prevent them from taking part in the inclusive transfers that will dominate the later stages of the count.

28. We can only guess at the likely numbers of such voters in future local government STV elections in Scotland, but results of the 2002 Dáil Éireann elections from constituencies for which we have complete ballots, may provide a relevant indication. In Dublin North, there were 12 candidates for four seats and one party nominated three candidates while another nominated two: 39% of the voters marked

only three preferences; 71% of voters marked only five preferences; under the counting rules in the Bill 70% of the ballot papers would remain with the voters' first preference candidates. In Dublin West, there were nine candidates for three seats and one party nominated two candidates: 46% of the voters marked only three preferences; 74% of voters marked only five preferences; under the counting rules in the Bill 46% of the ballot papers would remain with the voters' first preference candidates. If these patterns were repeated in future Scottish elections, substantial numbers of voters would be disadvantaged were the inclusive approach adopted.

Practical Consequences

29. The Local Government and Transport Committee has already noted that it would make counts unrealistically time consuming if the 'weighted inclusive Gregory method' of transferring consequential surpluses were implemented while ballot papers are sorted and counted manually. Manual sorting and counting would be impracticable if all the concomitantly essential provisions were also implemented to ensure the inclusive rules produced internally consistent results.

30. The Committee recommended that electronic counting should be introduced in time for the STV elections in 2007, and gave the possibility of adopting the 'weighted inclusive Gregory method' of handling consequential surpluses as one of its reasons for making this recommendation. The Committee did not, however, take any evidence on the need for transparency in the counting procedure although some witnesses made reference to it. Experience from Northern Ireland indicates that candidates and their agents attach considerable importance to their ability to observe and verify the whole procedure during every stage of the count. This contributes to public confidence in the outcome.

31. If electronic counting were introduced, it would enhance public confidence in that change if it could be correctly asserted that the whole procedure could be verified manually should that be necessary. This would be true if the provisions for transferring consequential surpluses remain as in the Bill, but it would not be true if the 'weighted inclusive Gregory method' and the related provisions were adopted.

32. Conclusions

- The 'weighted inclusive Gregory method' of transferring consequential surpluses should not be introduced without major concomitant changes to other parts the STV counting procedure.
- It would not be practical to introduce such changes without electronic counting of the ballot papers.
- Transparency would be lost and it would impracticable to verify the electronically counted result by a manual count if such changes were introduced.
- Introducing the 'weighted inclusive Gregory method' would have significant consequences for large numbers of voters, especially those likely to mark only a few preferences.
- The rules in the Local Governance (Scotland) Bill for handling consequential surpluses should not be changed at this time.

EXAMPLES ILLUSTRATING THE EFFECTS OF DIFFERENT STV COUNTING RULES FOR TRANSFER OF CONSEQUENTIAL SURPLUSES

EXAMPLES 1, 2, 3

Seats: 3-seat constituency

Candidates: 4 candidates (A, B, C, D)

Voters: 10,000 votes, all papers transferable

Quota: taken as 2,500 to simplify the presentation (actual quota = 2,501, but difference has no effect on the calculations or conclusions)

Pattern of votes:

A: 5,000 voters list A as first preference; B as second; C as third.

B: 2,000 voters list B as first preference; D as second.

C: 1,200 voters list C as first preference.

D: 1,800 voters list D as first preference.

(Details of other preferences omitted because these have no effect on the outcome)

Example 1

Gregory Method (Rules as in Local Governance (Scotland) Bill)

Candidate	First Prefs	Transfer A's surplus	Stage 2	Transfer B's surplus	Stage 3	
A	5,000	-2,500	2,500		2,500	Elected
B	2,000	2,500	4,500	-2,000	4,500	Elected
C	1,200		1,200	+2,000	3,200	Elected
D	1,800		1,800		1,800	
Total	10,000	=	10,000	=	10,000	

Example 2

Weighted Inclusive Gregory Method

Candidate	First Prefs	Transfer A's surplus	Stage 2	Transfer B's surplus	Stage 3	
A	5,000	-2,500	2,500		2,500	Elected
B	2,000	2,500	4,500	-2,000	2,500	Elected
C	1,200		1,200	+1,111	2,311	
D	1,800		1,800	+889	2,689	Elected
Total	10,000	=	10,000	=	10,000	

Example 3

Weighted Inclusive Gregory Method plus Transfers to Candidates Already Elected

Candidate	First Prefs	Transfer A's surplus	Stage 2	Transfer B's surplus	Stage 3	
A	5,000	-2,500	2,500		2,500	Elected
B	2,000	2,500	4,500	-2,000	2,500	Elected
C	1,200		1,200	+1,111	2,311	
D	1,800		1,800	+889	2,689	Elected
Total	10,000	=	10,000	=	10,000	

Explanation of Examples 1, 2, 3

Example 1 (last parcel transfer as in LG(S) Bill)

First stage: **A** is elected with a surplus of 2,500 votes.

Stage 2: Transfer all of A's 5,000 papers to next available preferences, ie B.
Papers transferred at reduced value of 2,500 votes / 5,000 papers = 0.5 vote.
B receives 2,500 votes and is elected with a surplus of 2,000 votes.

Stage 3

Transfer papers in **last parcel** received by B to next available preferences, ie C.
Papers transferred at reduced value of 2,000 votes / 5,000 papers = 0.4 vote.
C receives 2,000 votes and is elected.

Example 2 (all parcel transfer)

First stage: **A** is elected with a surplus of 2,500 votes.

Stage 2: Transfer all of A's 5,000 papers to next available preferences, ie B.
Papers transferred at reduced value of 2,500 votes / 5,000 papers = 0.5 vote.
B receives 2,500 votes and is elected with a surplus of 2,000 votes.

Stage 3

Transfer B's surplus. Surplus (2,000 votes) = $2,000 / 4,500 = 0.4444$ of B's total vote.

Transfer **all** of B's papers to next available preferences:

2,000 papers (value each 1.00 vote) B's first preferences, transferred to D.

5,000 papers (value each 0.5 vote) received from A, transferred to C

D receives 889 votes (= 2,000 papers x 1.00 x 0.4444)

C receives 1,111 votes (= 5,000 papers x 0.5 x 0.4444)

D receives 889 votes and is elected.

Example 3 (transfer all parcels plus transfers to candidates already elected)

First stage: **A** is elected with a surplus of 2,500 votes.

Stage 2: Transfer all of A's 5,000 papers to next available preferences, ie B.
Papers transferred at reduced value of 2,500 votes / 5,000 papers = 0.5 vote.
B receives 2,500 votes and is elected with a surplus of 2,000 votes.

Stage 3

Transfer B's surplus. Surplus (2,000 votes) = $2,000 / 4,500 = 0.4444$ of B's total vote.

Transfer **all** of B's papers to next available preferences:

2,000 papers (value each 1.00 vote) B's first preferences, transferred to D.

5,000 papers (value each 0.5 vote) received from A, transferred to C

D receives 889 votes (= 2,000 papers x 1.00 x 0.4444)

C receives 1,111 votes (= 5,000 papers x 0.5 x 0.4444)

D receives 889 votes and is elected.

With this vote pattern, Examples 2 and 3, both employing the 'weighted inclusive Gregory method', give identical results.

EXAMPLES 4, 5, 6

Seats: 3-seat constituency

Candidates: 4 candidates (A, B, C, D)

Voters: 10,000 votes, all papers transferable

Quota: taken as 2,500 to simplify the presentation (actual quota = 2,501, but difference has no effect on the calculations or conclusions)

Pattern of votes:

A: 4,500 voters list A as first preference; B as second; C as third.

B: 2,500 voters list B as first preference; D as second.

C: 1,200 voters list C as first preference.

D: 1,800 voters list D as first preference.

(Details of other preferences omitted because these have no effect on the outcome)

Example 4

Gregory Method (Rules as in Local Governance (Scotland) Bill)

Candidate	First Prefs	Transfer A's surplus	Stage 2	
A	4,500	-2,000	2,500	Elected
B	2,500		2,500	Elected
C	1,200	2,000	3,200	Elected
D	1,800		1,800	
Total	10,000	=	10,000	

Example 5

Weighted Inclusive Gregory Method

Candidate	First Prefs	Transfer A's surplus	Stage 2	
A	4,500	-2,000	2,500	Elected
B	2,500		2,500	Elected
C	1,200	2,000	3,200	Elected
D	1,800		1,800	
Total	10,000	=	10,000	

Example 6

Weighted Inclusive Gregory Method plus Transfers to Candidates Already Elected

Candidate	First Prefs	Transfer A's surplus	Stage 2	Transfer B's surplus	Stage 3	
A	4,500	-2,000	2,500		2,500	Elected
B	2,500	2,000	4,500	-2,000	2,500	Elected
C	1,200		1,200	889	2,089	
D	1,800		1,800	1,111	2,911	Elected
Total	10,000	=	10,000	=	10,000	

Explanation of Examples 4, 5, 6

Example 4 (last parcel transfer as in LG(S) Bill)

First stage

A is elected with a surplus of 2,000 votes.

B is elected with a quota of votes.

Stage 2

Transfer all of A's 4,500 papers to **next available** preferences, ie C, passing over B.

Papers transferred at reduced value of 2,000 votes / 4,500 papers = 0.4444 vote.

C receives 2,000 votes and is elected.

Example 5 (all parcel transfer)

First stage

A is elected with a surplus of 2,000 votes.

B is elected with a quota of votes.

Stage 2

Transfer all of A's 4,500 papers to **next available** preferences, ie C, passing over B.

Papers transferred at reduced value of 2,000 votes / 4,500 papers = 0.4444 vote.

C is elected.

Example 6 (transfer all parcels plus transfers to candidates already elected)

First stage

A is elected with a surplus of 2,000 votes.

B is elected with a quota of votes.

Stage 2

Transfer all of A's 4,500 papers to **next** preferences, ie B.

Papers transferred at reduced value of 2,000 votes / 4,500 papers = 0.4444 vote.

B now has a surplus of 2,000 votes.

Stage 3

Transfer B's surplus. Surplus (2,000 votes) = $2,000 / 4,500 = 0.4444$ of B's total vote.

Transfer **all** of B's papers to next available preferences:

2,500 papers (value each 1.00 vote) B's first preferences, transferred to D.

4,500 papers (value each 0.4444 vote) received from A, transferred to C

D receives 1,111 votes (= 2,500 papers x 1.00 x 0.4444)

C receives 889 votes (= 4,500 papers x 0.4444 x 0.4444)

D receives 1,111 votes and is elected.

With this vote pattern, Examples 5 and 6, both employing the 'weighted inclusive Gregory method', do NOT give identical results. To obtain consistent results with the 'weighted inclusive Gregory method' it is necessary also to make transfers to candidates who have already been elected, as in Example 6.

References

1. The Scottish Parliament Local Government and Transport Committee: 2nd Report 2004 (Session 2): Stage 1 Report on the Local Governance (Scotland) Bill.
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