Detailed Description of the STV Count in accordance with the Rules in the Scottish Local Government Elections Order 2007

Overview

Once the total number of valid ballot papers has been counted, the minimum number of votes a candidate needs to be elected is calculated (the "quota").

The ballot papers are sorted according to the first preferences (first choices) marked by the voters and the total number of votes for each candidate is counted.

Any candidate whose vote equals or exceeds the quota is elected. If any candidate has more votes than the quota, that surplus above the quota is transferred in accordance with the second and later preferences recorded on the ballot papers.

If after all the surpluses have been transferred some places remain to be filled, the candidate with fewest votes is excluded and that candidate's votes are transferred in accordance with the second and later preferences recorded on the ballot papers.

The transfers of votes continue until all the places have been filled.

The detailed Rules are illustrated by an example count for a 3-member ward in which the election was contested by 5 candidates and 2397 electors cast valid votes.

Calculating the Quota

Once the total number of valid ballot papers has been counted in each multi-member ward, the minimum number of votes a candidate needs to be elected in that ward is calculated. This number is called the "quota". The quota in a multi-member ward is equivalent to an absolute majority in a single winner election because in a 3-member ward only 3 candidates can obtain the calculated quota of votes. Thus the three candidates who each obtain one quota of votes are the three undisputed winners.

The election Rules prescribe the Droop Quota which is calculated as:

$$\frac{\text{total number of valid votes}}{\text{number of seats to be filled} + 1} + 1$$

If the result of the division is not an exact whole number, the remainder is ignored.

So in the example election the quota would be:

$$(2397 / (3 + 1)) + 1 \ = \ (2397 / 4) + 1 \ = \ 599 + 1 \ = \ 600 \text{ votes.}$$

Counting the First Preferences

All the valid ballot papers are sorted according to the first preference marked on each paper and the number of votes for each candidate is counted and recorded.

The specimen ballot paper at the top of the next page shows a first preference for Flora Campbell and would add one vote to her total of first preference votes.

Specimen Ballot Paper	
Jack Adams	2
Able Baker	4
Flora Campbell	1
Earl Gray	3
Windy Miller	

In the example election the numbers of first preference votes for each candidate were as follows:

Stage 1	First Preferences
Jack Adams	550
Able Baker	377
Flora Campbell	**972**
Earl Gray	167
Windy Miller	331
Total	2397

Flora Campbell, with 972 votes, is elected because her total number of votes exceeds the quota of 600. Flora Campbell has a surplus of 372 votes, i.e. 972 – 600, and this surplus must be transferred. If two or more candidates have surpluses, the largest surplus is transferred first. If Flora Campbell had received exactly 600 first preference votes she would have been elected, but there would be no surplus to transfer and her ballot papers would not be examined again. (Election by exact quota is very rare in real elections.)

Transferring Surplus Votes
The election Rules prescribe the use of the Weighted Inclusive Gregory Method (WIGM) to distribute the surplus votes. In this method **all** of the ballot papers held by the candidate with the surplus are examined. The surplus votes are transferred in accordance with the 'next available preferences' marked on those ballot papers by the voters.

The second stage of the example count is the transfer of Flora Campbell's surplus votes. All of the 972 ballot papers that were marked for Flora Campbell as first preference are now sorted according to the second preference marked on each paper. The Specimen Ballot Paper at the top of this page shows a second preference for Jack Adams and that paper would be transferred to Jack Adams.

If Jack Adams had also been elected at the first stage (because he had 600 or more first preference votes), that ballot paper would be transferred to Earl Gray as the 'next available preference', i.e. a candidate who has not yet been elected or excluded. Under WIGM, votes are not transferred to already elected candidates.

If no candidate had been marked as second preference, that ballot paper would be set aside a 'non-transferable'.

To transfer Flora Campbell's surplus of 372 votes, all 972 ballot papers are examined and transferred, but the value of these 972 ballot papers must be reduced to ensure that only the 372 surplus votes are transferred. This is done by calculating a 'transfer value' for each ballot paper. The transfer value represents the proportion of the votes to be transferred.

The WIGM Transfer Value (TV) prescribed in the election Rules is calculated as:

$$\frac{\textbf{surplus votes of elected candidate } \times \text{ current value of ballot paper}}{\textbf{total number of votes credited to elected candidate}}$$

Transfer values are calculated to 5 decimal places and any remainder is ignored. So for Flora Campbell's 972 ballot papers, all with a current value of 1 vote, the transfer value would be:

$$\frac{372 \times 1}{972} = 0.38271$$

The numbers of ballot papers transferred to each candidate are then multiplied by this transfer value to give the numbers of votes that are to be transferred to each candidate.

In the example election, candidate Jack Adams was marked as second preference on 357 of the 972 ballot papers that had Flora Campbell as first preference. So the number of votes to be transferred to Jack Adams on those 357 ballot papers would be calculated as: $357 \times 0.38271 = 136.62747$ votes.

The numbers of ballot papers that had second preferences for the other candidates were: Able Baker 223; Earl Gray 83; Windy Miller 252. There was no second preference marked on 57 of the ballot papers and these were set aside as non-transferable. So with each of the 972 ballot papers having a transfer value of 0.38271 votes, Flora Campbell's surplus of 372 votes would be transferred as shown in the following table:

Next available preference	Number of papers marked with second preference	Number of votes to be transferred (TV = 0.38271)
Jack Adams	357	136.62747
Able Baker	223	85.34433
Earl Gray	83	31.76493
Windy Miller	252	96.44292
No second preference	57	21.82035 *
Total	972	372.00000

* The total value of the Non-Transferable Votes is calculated separately

The effects of these transfers are as follows:

Candidate	Stage 1 First preferences	Campbell's surplus Votes transferred	Stage 2 Votes after transfer
Jack Adams	550	+136.62747	**686.62747**
Able Baker	377	+85.34433	462.34433
Flora Campbell	**972**	-372.00000	**600.00000**
Earl Gray	167	+31.76493	198.76493
Windy Miller	331	+96.44292	427.44292
Non-Transferable	-	+21.82035	21.82035
Total	2397	=	2397.00000

Jack Adams' total vote now exceeds the quota (600 votes) and so Jack Adams is elected. Jack Adams has a surplus of more than 86 votes and this surplus must now be transferred as there are three candidates for the one place that remains to be filled.

At the third stage of the count, **all** of Jack Adams' ballot papers will be examined and transferred. These ballot papers are of two different current values:

550 ballot papers with the first preference for Jack Adams: current value = 1 vote.

357 ballot papers transferred from Flora Campbell: current value = 0.38271 vote.

The Transfer Values for these two parcels of ballot papers are calculated separately, using the formula given on page 3 above. For the 550 first preference ballot papers, each with a current value of 1 vote, the transfer value will be:

$$\frac{(686.62747 - 600) \times 1}{686.62747} = 0.12616$$

For the 357 ballot papers received by transfer from Flora Campbell, each with a current value of 0.38271 vote, the transfer value will be:

$$\frac{(686.62747 - 600) \times 0.38271}{686.62747} = 0.04828$$

The ballot papers in the two parcels are sorted separately according to the next available preference marked on each paper, again passing over any preference for an already elected candidate. Ballot papers on which there is no next available preference will again be set aside as 'non-transferable'.

When the ballot papers which had Jack Adams as first preference are sorted, they will be transferred to the second preference marked on each paper unless that second preference is for Flora Campbell who has already been elected. If the second preference is for Flora Campbell, the paper will be transferred to the third preference.

When the ballot papers Jack Adams received from Flora Campbell at stage 2 are sorted, they will be transferred to the third preference marked on each paper. The Specimen Ballot Paper at the top of page 2 above, previously transferred from Flora Campbell to Jack Adams, shows a third preference for Earl Gray and that paper would be transferred to Earl Gray.

In the example election the numbers of ballot papers with preferences for each of the remaining three candidates are shown separately for each parcel of papers in the next table, together with the numbers of votes that will be transferred:

Parcel of Ballot Papers	Papers with Jack Adams as first preference (550)		Papers transferred from Flora Campbell (357)		Total Votes to be transferred
Next available preference	Number of papers with next preference	Votes to be transferred TV = 0.12616	Number of papers with next preference	Votes to be transferred TV = 0.04828	
Able Baker	35	4.41560	7	0.33796	4.75356
Earl Gray	400	50.46400	49	2.36572	52.82972
Windy Miller	78	9.84048	263	12.69764	22.53812
No further preference	37	-	38	-	6.50607 *
Total	550	-	357	-	86.62747

* The total value of the Non-Transferable Votes is calculated separately

The effects of these transfers are shown in the next table:

	Stage 1	Campbell's surplus	**Stage 2**	Adams' surplus	**Stage 3**
Candidate	First preferences	Votes transferred	Votes after transfer	Votes transferred	Votes after transfer
Jack Adams	550	+136.62747	**686.62747**	-86.62747	**600.00000**
Able Baker	377	+85.34433	462.34433	+4.75356	467.09789
Flora Campbell	**972**	-372.00000	**600.00000**		**600.00000**
Earl Gray	167	+31.76493	198.76493	+52.82972	251.59465
Windy Miller	331	+96.44292	427.44292	+22.53812	449.98104
Non-Transferable	-	+21.82035	21.82035	+6.50607	28.32642
Total	2397	=	2397.00000	=	2397.00000

Jack Adams' surplus has been transferred, but it has not brought the vote of any other candidate up to the quota. Thus one place remains to be filled.

So the next stage must be to exclude the candidate with the smallest number of votes, in this case, Earl Gray who has 251.59465 votes while Windy Miller has 449.98104.

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Excluding a Candidate

When a candidate is excluded, all of that candidate's ballot papers are examined and transferred to the next available preference marked on each paper. Each ballot paper is transferred at its current value.

The candidate who is to be excluded in the example election, Earl Gray, has ballot papers of four different values:

  167 ballot papers with the first preference for Earl Gray:
        current value of each paper = 1 vote.

  83 ballot papers transferred from Flora Campbell:
        current value of each paper = 0.38271 vote.

  400 ballot papers transferred from Jack Adams:
        current value of each paper = 0.12616 vote.

  49 ballot papers transferred from Jack Adams after transfer from Flora Campbell:
        current value of each paper = 0.04828 vote.

The ballot papers in each of these four parcels are sorted separately according to the next available preference marked on each paper, again passing over any preference for an already elected candidate. This means that the ballot papers can be transferred only to Able Baker or Windy Miller. Ballot papers on which there is no next available preference will be set aside as 'non-transferable'.

The Specimen Ballot Paper at the top of page 2 above, would be in the fourth parcel of 49 papers because it had previously been transferred from Flora Campbell (first preference) to Jack Adams (second preference) and then from Jack Adams to Earl Gray (third preference). That paper would now be transferred to Able Baker (fourth preference) and add 0.04828 vote to Able Baker's total vote.

In the example election the numbers of ballot papers with preferences for the remaining two candidates are shown separately for each parcel of papers in the first table on page 7, together with the numbers of votes that will be transferred.

The effects of these transfers are shown in the Final Result table on page 7. The transfer of 152.79922 votes to Windy Miller brought his total vote to more than 602 votes. This exceeds the quota and so Windy Miller takes the last of the three places.

Filling the Last Places

If at any stage during the count, the number of continuing candidates, i.e. those not elected and not excluded, is equal to the number of places remaining to be filled, those candidates are elected. In this event, no further transfers of ballot papers and votes are made, even if the last elected candidates have not attained the quota.

Provision for Tied Votes

When a surplus has to be transferred or a candidate has to be excluded, two candidates sometimes have exactly the same number of votes. If this happens, the Returning Officer will look back through the count for the most recent stage at which there was a difference between the votes of the two candidates. If a difference is found at an earlier stage, the candidate with the higher number of votes (in the case of a surplus transfer) or the lower number of votes (in the case of an exclusion) will have their ballot papers transferred first. If there was no difference at any stage, the Returning Officer will determine by lot which surplus to transfer or which candidate to exclude.

Transfer of Earl Gray's votes on exclusion

Parcel of Ballot Papers	Earl Gray first preference		Transferred from Flora Campbell		Transferred from Jack Adams		Transferred from Jack Adams after transfer from Flora Campbell		Total Votes to be transferred
Next available preference	Number of papers with next preference	Votes to be transferred TV = 1.00000	Number of papers with next preference	Votes to be transferred TV = 0.38271	Number of papers with next preference	Votes to be transferred TV = 0.12616	Number of papers with next preference	Votes to be transferred TV = 0.04828	
Able Baker	54	54.00000	15	5.74065	84	10.59744	7	0.33796	70.67605
Windy Miller	96	96.00000	58	22.19718	267	33.68472	19	0.91732	152.79922
No further preference	17	17.00000	10	3.82710	49	6.18184	23	1.11044	28.11938
Total	167	167.00000	83	31.76493	400	50.46400	49	2.36572	251.59465

Final Result

Total valid vote = 2397   Number to be elected = 3   Quota = 600

Candidate	Stage 1	Campbell's surplus	Stage 2	Adams' surplus	Stage 3	Gray's exclusion	Stage 4	
	First preferences	Votes transferred	Votes after transfer	Votes transferred	Votes after transfer	Votes transferred	Votes after transfer	
Jack Adams	550	+136.62747	**686.62747**	-86.62747	**600.00000**		**600.00000**	**Elected**
Able Baker	377	+85.34433	462.34433	+4.75356	467.09789	+70.67605	537.77394	
Flora Campbell	**972**	-372.00000	**600.00000**		**600.00000**		**600.00000**	**Elected**
Earl Gray	167	+31.76493	198.76493	+52.82972	251.59465	-251.59465	0.00000	
Windy Miller	331	+96.44292	427.44292	+22.53812	449.98104	+152.79922	**602.78026**	**Elected**
Non-Transferable	-	+21.82035	21.82035	+6.50607	28.32642	+28.11938	56.44580	
Total	2397	=	2397.00000	=	2397.00000	=	2397.00000	