Computerisation of STV counts

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This note, located by David Hill, appears not to have been published. It is dated February 1983. It is unclear why it was not published. Since it raises many interesting issues, it is reproduced here. Readers may wish to comment on the proposals. We hope to include their comments in a subsequent issue of *Voting matters* — Editor.

(1) It has often been suggested that STV counts should be computerised to save time/money. I have always regarded that view as unrealistic. Much of the time of any election count is taken up with preliminaries, such as envelope-slitting in postal ballots, unfolding voting papers, checking their authenticity, and, in public elections, reconciliation of numbers of papers issued.

With computerised counts, input would be time-consuming, whether by operators working in pairs to ensure accuracy, or whether by special equipment reading special voting papers presented in succession. Voting machines capable of accepting preferences seem an unlikely investment for infrequent public elections.

The time required for manual STV counts can be exaggerated, while any saving in time/money in computerised counts is doubtful or marginal. Unless there are other positive advantages to be gained from the computerisation of STV counts, it seems wrong to deprive candidates and others of the opportunity of witnessing manual counts.

(2) As Stephen Freeland said in his recent paper, COUNTING STV BY COMPUTER, "the existing 1976 procedures for counting STV elections represent a balance between technical refinement and speed of counting". Indeed, the 1976 procedures included improvements over earlier procedures both in technical refinement *and* in speed of counting. The current (1976) procedures are probably the best that can be achieved in manual counts.

Although little can be said in favour of computerisation of STV counts if the objective is merely the supposed saving of time/money, nevertheless, if computerisation is intended, the opportunity can be taken of incorporating improved counting procedures into STV which are not practicable in manual counts.

One minor improvement is obvious. It would be absurd to write a computer program restricting the calculation of quota, $V/(N+1)$, and of transfer values, to two decimal places. Using more decimal places would, on occasion, lead to a different, better, result. Since the results of manual and computer counts would then no longer be comparable, it would be sensible to make other improvements to achieve even better, different, results.

(3) In my COMPARATIVE ELECTORAL SYSTEMS where I was concerned primarily with the comparison of systems employing manual counts, I indicated briefly in section 7.8(c), Further Refinements, two areas of improvement not practicable in manual counts, viz., (i) the recommencement of counts from the beginning after exclusions, and (ii) the transfer of voting papers to next preferences even though already elected.

Stephen Freeland discusses the first of these in his paper. Following exclusion, often some voting papers are non-transferable. In consequence, towards the end of the count, candidates are elected without the quota: votes are of unequal effect.

The remedy is to re-commence the count ab initio after each exclusion. (A)

Non-transferable papers showing preferences only for excluded candidates would be discarded, and a new, lower, quota would be calculated. Eventually all candidates would be elected on attaining the same (lowest) quota: votes would be of equal effect.

Non-transferable papers showing preferences for already elected candidates would now be used to help elect those candidates: there would be fewer non-transferable papers.

Moreover, a well-known tactical voting ploy

would be pre-empted. Suppose that in an election with quota 9, candidate A has 10 voting papers: 9 AB, 1 AC. The count proceeds thus:

A	10	−1	9
B	-	+0.9	0.9
C	-	+0.1	0.1

Under current rules, the elector who voted AC can maintain his support for A, but increase his support ten-fold for C by voting ZAC, where Z is not the elector's genuine first choice, but is believed to have little or no support. The count proceeds:

A	9		9
B	-		-
C	-	+1	1
Z	1	−1	-

There is an inherent danger that many such tactical voters might elect Z unintentionally.

Such tactical voting is pre-empted if the count is re-commenced after the exclusion of Z:

A	9	
B	-	
C	-	
Z	1	excluded.

New start:

A	10	−1	9
B	-	+0.9	0.9
C	-	+0.1	0.1

(4) In manual counts, it is standard practice, in transferring a consequential surplus, only to examine, and where appropriate transfer, those papers, all of one value, last received, which gave rise to the surplus. It is sometimes suggested that *all* the papers of an elected candidate should be examined and where appropriate transferred, since they all contributed to the existence of the surplus. This is an apparently attractive argument, but such a procedure, by itself, is unsound.

Suppose that in an election with quota 8, candidate A has 10 papers marked ABCD, B has 8 papers, and C has 7 papers. The count proceeds:

A	10	−2	8	
B	8		8	
C	7	+2	9	−1

It would clearly be unsound to examine and transfer any of the original 7 papers for C while the larger number of 8 papers for B have no further effect on the count. The 8 papers for B remain unexamined because B had already attained the quota, and the surplus of A was transferred, passing over B, direct to C.

The remedy is to transfer voting papers to next preferences even if already elected, thereby enabling all voting papers of an elected candidate to be examined when a consequential surplus is transferred. (B)

Electors would then be more equally represented.

Suppose in an election with quota 10, preferences for candidates A, B, C are shown on 30 voting papers: 20 AB, 10 BC. The count proceeds under existing rules thus:

A	20	−10	10
B	10		10
C	-		-
NT	-	+10	10

But if the surplus of A is transferred to the next preference B, the count proceeds:

A	20	−10	10		10
B	10	+10	20	−10	10
C	-		-	+10	10

The 30 electors with three quotas of votes have now elected three representatives.

The practical difficulty with this desirable procedure is that if part of the surplus of a candidate A is transferred to a candidate B, who is already elected, or may thereby be elected, part of B's surplus may be transferred to A, and then part of A's surplus to B, and so on indefinitely.

Brian Meek examined the problem in some detail in EQUALITY OF TREATMENT OF VOTERS AND A FEEDBACK MECHANISM FOR VOTE COUNTING, papers published in 1969 and 1970 in *Mathematiques et Sciences Humaines* (English language versions available).

Douglas Woodall also discusses the problem in COMPUTER COUNTING IN STV ELECTIONS in the current issue (Winter 1982-83 issue) of *Representation*.

To illustrate the effect of transferring votes between elected candidates, suppose that in an election with quota 12, candidate A has 18 papers, and candidate B has 10 papers. The papers for candidate A are marked: in case (i) 18 ABC (ii) 15 ABC, 3 A

(iii) 6 ABC, 12 A In each case the 10 papers for B are marked BAD.

Under existing rules, except for non-transferable differences, the result in each case is the same. The consequential surplus of B is transferred entirely to C, and D receives nothing:

A	18	−6	12		12
B	10	+6	16	−4	12
C	-		-	+4	4
D	-		-		-

If voting papers are transferred between A and B however, D receives votes in each case; fewest votes in case (i) when most papers show a (third) preference for C; most votes in case (iii) when fewest papers show a preference for C. In case (iii) the transfers soon terminate, but in the other two cases there is a theoretically unending alternation of transfers as the votes credited to A and B gradually converge to the quota. In practice, the calculations are terminated when a desired degree of accuracy is attained.

Details are appended. In case (iii) the transfers are worked out fully. In cases (i) and (ii) only the early alternations are shown [1].

It may be noted that I have followed principles which differ in some respects from both Meek and Woodall.

(5) If STV counts are to be computerised, it would be foolish not to include remedy (A), since to recommence the count after each exclusion requires only a little more computer time. If satisfactory computer programs can be devised, it would also be appropriate to include remedy (B), incorporating the procedures as illustrated.

A manual STV count is already immensely superior to any other method of election, votes being of nearly equal effect. Remedies (A) and (B) are designed to treat voting papers equally, and to ensure that votes are of exactly equal effect.

(6) This paper makes no suggestion to change the apparently obvious criterion of successively excluding candidates with fewest votes. I know of no better criterion.

The procedures described above will ensure that at most a quota of voters is not represented. Different criteria for exclusion would merely result in the non-representation of a different quota of voters.

[1] These details have been omitted here because Newland changed his mind later. When the members of ERS Technical Committee were arguing between three alternative ways of doing the job: Newland, Meek and Warren, he had another look at it and switched to supporting the Meek method as better than what he had proposed in this paper, so it is fairer to him to ignore his proposed method.