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Voting matters

for the technical issues of STV

The Electoral Reform Society

Issue 11 April 2000

Editorial

This publication has now entered the Internet age! Future issues will appear on the ERS Web site (http://www.electoral-form.org.uk). Those who have no access to the Internet and do not wish to do so, need not be concerned, since a printed copy will continue to the available from ERS as before.

As Editor, I will ensure that those without Internet access are at no disadvantage. On the other hand, I would be happy to receive articles by e-mail to Brian.Wichmann@freenet.co.uk. Material should be in standard formats, such as HTML or PDF (and also RTF), rather than in proprietary word-processor formats.

Although the ERS Web site will have the current issue, there will be some delay in conversion and checking before it will be available there. Hence the printed copy should be available first, and that version should be regarded as the authoritative source (due to conversion and presentation problems with HTML).

I hope to arrange for all the back issues to be available on the Internet via a suitable Archive site. I have prepared a 'combined' issue for all of Issues 1-10, which is available from me in electronic format (HTML and PDF). Unfortunately, since this combined issue amount to 112 pages, it has not been possible for it to be professionally printed, since the cost is excessive for the likely sales.

The delay in this issue indicates the continuing problem of the lack of material from a small authorship. I am hoping that exposure of the material to international access via the Internet will encourage other parties to contribute in the future.

In the first article, Hugh Warren suggests a way of merging STV with FPTP, at least as far as the ballot itself is concerned. Could this encourage STV counting? Comments are welcome.

Philip Kestelman provides another article on proportionality with reference to the Jenkin's proposals.

Earl Kitchener makes a suggestion that Borda scores should be used to break tie rather than relying on a random choice (at least in the first instance).

My own article on checking two STV computer programs has proved controversial due to the issue of quota-reduction which is one of the new features in the 1997 edition of the ERS hand-counting rules. This issue is explained in the following article by David Hill; and Colin Rosenstiel, as co-author of the new rules, provides a response. Readers should judge for themselves whether a revision to the rules is required to ensure that no ambiguity exists.

Brian Wichmann.

Incorporating X-voting into Preference voting by STV

C H E Warren

Hugh Warren is a retired mathematician

1. Introduction

One of the thing said by many people, particularly by those who have used the X-voting system for many years, and by journalists, is that preference voting by STV is difficult to understand. However much advocates of preference voting by STV may find this view unjustified, and itself difficult to understand, they must accept that it is a view that is expressed, and no doubt genuinely held by a lot of people.

The purpose of this paper is to make the point that, instead of trying to win over the X-voting enthusiasts to the STV way of voting, consideration should be given to allowing the X-voting enthusiasts into the preference voting by STV system.

2. The Basic Idea

The basic idea is that, in addition to those who wish to vote in the STV way by showing preferences 1, 2, 3, .. in the recognized way, those who wish to vote by putting an X against the candidates they wish to see elected should be allowed to do so, provided of course that they do not put an X against more candidates than the number to be elected.

3. Interpretation of the Ballot Paper

With some ballot papers marked in the STV way by preferences 1, 2, 3,.. and some marked by an X against a number of candidates, the way in which it is suggested that the two may be accommodated is to treat the X votes as equal preference for a first preference candidate.

The allowing of equal preferences in the STV system is a matter which has been talked about in the past, but usually ruled out on the grounds that it would make an already complicated system more complicated. However, to allow equality of preference to be exercised on the first preference only should not lead to seriously greater complexity.

4. The count

The count is not of course a matter with which the voters have to concern themselves, provided that they can be assured that it is being done in a fair way.

If there are, say, 10 candidates to be elected, then at the first stage of the count, each candidate will have a number of votes of value 1 from the preference votes, and a number of votes of value 0.1 from the X-votes.

From this point onwards the count can proceed just as if it were a regular STV count, except that, of course, when surpluses have to be transferred, it will only be the preference votes for which the amount retained will be reduced, thereby allowing some of the vote to be transferred to the next preference.

5. Conclusion

The advocates of preference voting by STV have been trying for over 100 years to beat the advocates of X-voting. There is an adage which says *If you can't beat them, join them*. What is proposed here is not so much a case of joining them as incorporating them.

It is possible that, in the course of time, the X-voters will see that their interests could be better served by going across to preference voting, but the proposal is not to try and force STV on them.

Editorial Comment

The above proposal effectively merges the voting methods of First Past The Post and STV, so that the user can choose which method to employ. However, given that an STV-style count is to be undertaken, it seems logical to make an extension to Warren's proposal as follows: Allow the voter to place any number of X's on the ballot paper. Each X counts as a first-preference value of 1/*n*, where *n* is the number of X's. With this proposal, an election for a single candidate in which the voter judges two candidates as of equal merit and no others of interest, two X's can be used, counting as 0.5 for each. More significantly, in my own experience for some elections, one can have, say, 6 seats to fill, but one has knowledge of only, say 3 candidates. Under conventional X-voting (and Warren's proposal) one could place 3 X's and loose half of ones voting power. Under this suggestion, 1/3 of a vote would go to each candidate and there would be no loss of voting power.

AV-plus, PR and Essential AMS

Philip Kestelman

Nomenclature

Much like Proportional Representation (PR), Single Transferable Voting (STV) is not an electoral system but a *principle*. There are various forms of STV: single-member STV, better known as Alternative Voting (AV); and multi-member STV, using various counting procedures (with potentially different results).

In October 1998, the Independent Commission on the Voting System (ICVS) recommended AV-plus for electing 659 UK MPs: mostly in around 543 AV constituencies, with 15-20 percent compensatory MPs, in 80 relatively small Top-up areas (electing 4 - 11 total MPs per area, including one or two Additional Members). Compensating parties under-represented by Constituency MPs (AV), d'Hondt allocation of Top-up MPs would render total MPs semi-proportional to Second / Party Votes, with choice of candidate within party (Open List PR[4]).

Is AV-plus a form of PR? Is AV-plus an Additional Member System (AMS)? Indeed, is AV-plus a form of multi-member STV? Answers to all three questions depend on what you mean by PR, AMS and STV, respectively!

Proportional Representation

Ritchie (*Tribune*, 11 June 1999) has argued that

"The Jenkins Committee's recommendations have much to recommend them, but there is little more chance of them delivering a proportional result than there is under the present system".

His introduction of a probabilistic element is welcome: here comparing AV-plus with so-called 'First-Past-the-Post' (FPP).

Jenkins[4] estimated that, in the 1997 UK General Election (FPP), AV-plus would have reduced the "DV score" from 21 percent to 13.2 percent. Measuring Deviation from Proportionality, DV = Loosemore-Hanby Index = LHI[8]. LHIs of 4 - 8 percent represent practically "full proportionality"; and for AV-plus, Jenkins[4] claimed only 'broad proportionality'.

Compare other d'Hondt systems. In the May 1999 Scottish Parliamentary Election (FPP-plus: seven Top-up MSPs per Region × 8 = 56 / 129 = 43 percent), the Second / Party Vote LHI was 10.5 percent. Ironically, total MSPs proved more representative of First / FPP Votes (LHI = 5.4 percent)! In the May 1999 Welsh Assembly Election (FPP-plus: four Top-up MWAs per Region × 5 = 20 / 60 = 33 percent), the Party Vote LHI was 11.2 percent (*Guardian*, 8 May 1999).

In Britain, the June 1999 European Parliamentary Election LHI reached 14.1 percent (Closed List PR: 84 MEPs: 4 - 11 per Region: *Guardian*, 15 June 1999): 'broad proportionality'. Such pure d'Hondt seat allocation favours larger parties, proving considerably less representative than Largest Remainder (which would have yielded LHI = 6.1 percent).

Over the last 10 Irish general elections (multi-member STV, 1969-97), aggregate First Count LHI averaged 7.0 percent (ranging 3.4 - 12.9 percent between elections: from 'full PR' down to 'broad PR' in 1997). Between three- and five-member STV constituencies (averaging 7.0 and 7.4 percent, respectively), LHIs differed insignificantly[7]. In the June 1998 Northern Ireland Assembly Election (six-member STV), First Preference LHI was 6.6 percent (*Irish Times*, 29 June 1998).

Additional Member Systems

Now used in Germany, New Zealand, Scotland and Wales, FPP-plus is frequently referred to misleadingly as *the* AMS. Thus Bogdanor[2]:

"the additional member system is, conceptually, a 'closed' list system ... it combines many of the faults of the first-past-the-post system with many of the defects of list systems of proportional representation".

Confusingly, Bogdanor was alluding to "a variant of the German system", recommended by the Hansard Society Commission on Electoral Reform: FPP without separate party voting, topped-up regionally with FPP 'best losers' (25% of all MPs[1]).

At the 1994 German General Election, 328 Constituency MPs were elected by FPP (First Votes); d'Hondt allocating 328 Top-up MPs, in 16 Regions, according to Second Votes (Closed List PR[9]). However, Second Votes may indicate voters' *second* preference parties[5]; as suspected in the 1999 Scottish and Welsh elections (*Times*, 8 May 1999):

"All electors then had a second vote. This should have been used to indicate their favourite political party. There is widespread confusion on this point and the fear that some people thought that they were being asked for their second preference".

Voting separately for constituency MPs and parties — One Voter *Two* votes — may well encourage tactical (insincere)

voting. Especially in areas safe for the most-favoured party, a Second Vote for that party would elect no Top-up MP (and thus be wasted); and it would be more rational to vote for a less-favoured party, against a least-favoured party[4].

The average area represented by a German MP under FPP-plus in 1994 was over 20 times that of 656 FPP constituencies. In contrast, the mean area covered by each MP under AV-plus, with two Top-up MPs per area, would be only three times that of 659 FPP constituencies — just like three-member STV!

STV-plus

It is not widely realised that, in Malta since 1987, five-member STV has operated with a conditional AMS[6]. At the 1981 General Election, the Nationalist Party received an absolute majority of First Preferences (50.9 percent), but a minority of STV seats (31 / 65 = 47.7 percent).

Public outrage forced a constitutional amendment, guaranteeing a bare parliamentary majority to a party exceeding half of all STV First Preferences. At the 1987 Maltese General Election, the Nationalists won the same majority of First Preferences (50.9 percent), and minority of STV seats (47.7 percent); and therefore received four additional seats (totalling 35 / 69 = 50.7 percent of all MPs).

The 1992 General Election required no compensatory seats. Yet at the 1996 General Election − with fine impartiality − the Maltese Labour Party won 50.7 percent of First Preferences, but only 47.7 percent of STV seats! Accordingly, for a bare parliamentary majority, Labour received four additional seats (again totalling 50.7 percent of all MPs).

These few compensatory seats (4 / 69 = six percent) were occupied by STV Final Count ‘best losers’: runners-up for the party under-represented by STV alone. Thus Additional Members both stood for election and retained their constituency links.

The Maltese AMS (STV-plus) neatly solved an acute political problem. Incidentally, Malta remains a two-party polity, despite the opportunities for party fragmentation afforded by multi-member STV.

In the June 1998 Northern Ireland Assembly Election, the Social Democratic and Labour Party won more STV First Preferences than the Ulster Unionist Party (177,963 / 172,225 votes); but fewer Members (24 / 28 seats). That owed little to vote-transfers (*Irish Times*, 26 June 1998): even SDLP final ‘preferences’ exceeded those for the UUP (191,091 / 185,560 votes). The SDLP deserved five Additional Members (29 / 28 total seats proportionating SDLP to UUP).

STV-plus could well be generalised to British conditions; and would remedy the corruption of Party Vote Management — a form of tactical voting which disfigures Irish STV[3]. Party Vote Management involves a party’s supporters spreading their First Preferences evenly among its candidates: intended to keep them in the STV count for as long as possible (hoovering up stray transfers). In addition, each party nominates one more candidate than it expects seats; avoiding premature elimination through spreading its votes too thinly (‘over-nomination’).

Proportionating total (Constituency + Compensatory) seats to Party First Preferences, STV-plus could also reconcile the main parties (fearing the spectacle of disunity) to multi-member STV's wider choice of candidate. With each party's candidates competing for the voters’ affections, their First Preferences would *complement* each other in determining parliamentary party strengths under STV-plus. AV-plus could be redeemed likewise.

Essential AMS

AV-plus clarifies that AMS is not essentially FPP or Closed Party Lists. Both STV-plus (e.g. Malta), and the Hansard Society Commission variant of the German AMS, show that separate voting for Constituency Members and Parties is equally inessential. Anxious to avoid “all traces of a party list”, the Hansard Society Commission recommended that all candidates should stand in constituency elections[1].

Likewise, the ICVS stressed “open as opposed to closed lists for Top-up members”: Second / Party Votes offering a choice of candidate[4]. However, with three candidates per major party, preferential (rank-ordered, numbered) Second Votes are clearly better than categorical (single choice, X-marked) voting.

In that case, why not simply integrate First / AV with Second / Party votes: semi-proportionating total (AV + Top-up) MPs to AV First Preferences; with AV Final Count ‘best losers’ as Top-up MPs? Aiming to maximise AV First Preferences (and hence total MPs), each party would become highly motivated to nominate more than one candidate per constituency.

Thus could an improved AV-plus increase voter choice, both within and between parties. With a transferable choice of candidate within party, Party First Preferences are most sincere.

The ICVS argued that separating Constituency from Party votes would liberate voters from unwanted candidates of preferred parties; and that transmuting Constituency ‘best losers’ into Top-up winners would be hard to explain[4]. Valid against FPP-plus, both objections are much attenuated by more than one AV candidate per Constituency Party.

One Voter One Vote could then become far less wasteful than One Voter Two Votes. In both Scottish and Welsh

elections, around half of both First and Second votes elected nobody (*Guardian*, 8 May 1999).

Moreover, the ICVS version of AV-plus (switching between preferential and categorical voting) is even more complicated for voters than multi-member STV. Indeed, it has been argued — rather cruelly — that its very complexity would favour that next step!

Conclusions

ICVS-proposed AV-plus is an Additional Member System (AMS), mediating semi-PR ('broad proportionality'). AMS is confined neither to FPP-plus nor to separate Constituency and Party List voting.

AV-plus would be simplified by integrating Constituency with Party voting, each party nominating more than one AV candidate per constituency; rendering total MPs semi-proportional to First Preferences; and exploiting the rich crop of Final Count 'best losers' as Top-up MPs. AV-plus could thus achieve much towards multi-member STV (which may also benefit from some mild topping-up: STV-plus).

It remains unclear why the Scottish Parliament includes more Top-up Members (43%) than the Welsh Assembly (33%): both more than the ICVS-proposed House of Commons (15-20%). With 20−25 percent Top-up MPs, AV-plus would increase Party Representativity ('proportionality').

In the end, *parties* must nominate parliamentary candidates; while the voter's predicament is paramount. With preferential voting in fairly small Top-up areas, AV-plus essentially places PR on a human scale. Commitment to that principle need not rule out debate on technical improvements (short of multi-member STV) before the Referendum.

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Tie-Breaking in STV

Earl Kitchener

It is a fundamental principle of STV that later preferences should not affect the fate of earlier ones; this encourages sincere voting, but means that some arbitrary or random choice must be made to break ties, which can give unreasonable results.

An extreme case can arise where there is one seat and the electors are the same as the candidates; for example, if a partnership is electing a senior partner. Each candidate may put himself first, and all, except candidate A, put A second. Under most present rules, one candidate then has to be excluded at random, and it may be A. There is no way of getting over this unreasonable result without looking at later preferences, and the system of Borda scores is probably as good as any; with N candidates, N-1 points are allotted to a first preference, N-2 to a second, and so on. If it were desired to increase the importance of early preferences, the interval between values could be increased for early preferences. Ties in this system would be very rare, and it could be used to break ties in the normal STV counting.

In the above example no candidate or voter could reasonably object to the result, but in a real election, reported by Hill[1], with four candidates for one place, the voting was:

```
A B C     1
B A D     1
A C D B   1
B C A     1
```

The quota is two, which both A and B have. Under the proposed system A, with nine, beats B's eight. The second voter may complain that his second preference, for A, enabled A to beat his first preference. If the second voter had known in advance how the others were going to vote, he would not have put A second; but it is not unusual in small STV elections for a voter to find that if he had known the other voters' intentions

he would have voted differently. He has got his second preference in, so has not much to complain about. In view of the uncertainty of voting intentions it is doubtful whether the proposed rule would lead to insincere voting, and it would avoid the possibility of A being unreasonably excluded in the first example. It has the virtue of satisfying Woodall's "No support" property[2], that no candidate who is not listed by any voter should be elected unless every candidate who receives some support is elected.

Hill has described a Sequential STV system[3] which deals in a more general way with the problem of premature exclusion of a candidate with few first preferences, but many other early ones; Hill does not recommend it, because of the breach of the rule against looking at later preferences. The present proposal, being confined to tie-breaking, might be less likely to lead to insincere voting, which is the main (and perhaps the only) objection to looking at later preferences.

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Checking two STV programs

B A Wichmann

Last year, I received a request from the Electoral Reform Ballot Services to 'validate' the computer software that they use to perform elections for their customers. Before that work was finished, I had another request from ERS itself to re-certify the program used to perform elections in the Church of England. Since there was a substantial overlap between both of these activities, these are reported together.

The checking undertaken was merely to ensure that the election results reported were as required by the respective rules. Hence many issues which might be of interest were not examined, such as: the user-friendliness, speed and memory requirements, number of satisfied users, maturity of the program, etc. In fact, the two programs which were tested are very different: David Hill's program is a complete system for data entry and edit, counting and presentation of the results and has been available for some years. In contrast, Keith Edkins' program is solely a counting program and is a recent development.

ERBS's requirements were identified as mainly to check a program that implements the ERS rules that were published in 1997[1] (ERS97). However, their requirements are significant in terms of the capacity required, amounting to the ability to handle up to 350 candidates and up to 250,000 votes. In principle, modern computers have no inherent difficulty in handling elections of that size, provide the software is designed appropriately.

If software is to be shown to be reliable, then a large number of test cases need to be run, or an alternative means needs to be devised to show logically that all the relevant functionality is correctly implemented. In performing the first certification of the Church of England rules in 1990, the technique adopted was to ensure that all the code in David Hill's counting engine was executed, and that the election results obtained were correct (checked by Eric Syddique). It was not thought that the same technique could be applied effectively for the ERBS validation, so the use of many tests was used instead.

If high reliability is to be demonstrated then several hundred tests should be run (corresponding to some years of use by ERBS). This immediately gives a difficult problem — how can one be assured that the result produced by the computer is correct? Initially an attempt was made to determine a small number of tests which performs all the relevant functionality which would then make manual checking feasible. However, the individual actions in ERS97 are quite numerous and difficult to identify — for instance, the result sheet does not state many specific actions undertaken during a count. Hence it seemed that the best means for undertaking the checking was to compare two programs for the ERS97 rules which were available.

Comparing two programs to increase reliability is not widely regarded[2], but in this case, the two programs were known to have very different internal workings and were quite independently developed. Hence it was thought that the comparison would be effective.

Unless comparisons can be made automatically by program, the number of tests will be limited to a level which would not give the assurance needed. Hence to facilitate such comparison and to avoid the need for the STV programs to produce elaborate printing, an output format was designed that could be input into a spreadsheet for printing. This format is logically just the conventional Result Sheet, but specified so that mechanical checks, such as those on row and column arithmetic, can be made. I am grateful to both authors that they amended their programs to produce this output since the testing would have been very tedious without that. Two small differences were located between the programs but an analysis showed that neither could change the result. Finally, the comparisons were automated which resulted in a successful validation of Keith Edkins' program.

No formal validation was undertaken of David Hill's program for these rules, but, of course, the same results were obtained. The program is not designed to handle ERBS's very large elections. It currently has 50 as its maximum number of candidates. ERBS would also wish for Colin Rosenstiel's interpretation of the quota reduction rules to be applied, but this has not been implemented, as explained in David Hill's article[3].

A number of issues arose from the validation as follows:

Quota reduction

A logical problem has been noted by David Hill in ERS97 which arises when the quota is reduced before any candidate is elected. This issue is defined and discussed in a separate article in this issue[3]. The consequences for this validation was that no comparison was possible when this situation arose since David Hill's program does not produce a result, due to the uncertainty in the meaning of the rules. The problem can be regarded as serious, since around 25% of those tests which are based upon real elections involved quota reduction. I decided that I could not formally sign my validation report, since, in my opinion, the meaning of the rules was sufficiently uncertain in this respect. Subsequent to undertaking this work, an analysis showed that the problem could only arise when transfers occurred after quota reduction. For instance, this cannot happen when there is only one seat. An analysis of my election data suggests that the quota reduction problem actually arises in about 12% of real elections. Readers can decide for themselves the significance of this problem from the two articles about quota reduction in this issue[3,8].

New data base

The data base of election data described in *Voting matters*[4] has been substantially enhanced as a result of both validations. This data is now available on a CD-ROM. In order to facilitate the collection of data from real elections, a program has been written, available as a MS-DOS/Windows program, which produces an anonymous version of election data by taking a statistical sample. Anybody can therefore add data to the collection without concern for the confidentiality of the source. (The data base contains the results for each election for the two rules being considered here, and also for the Meek rules.)

Capacity tests

In order to check that large elections could be handled, a program was written to generate large test data together with the results in result sheet format. This technique showed that these large tests can indeed be handled by any modern PC.

Tie-breaks

If an election requires the use of a tie-break, then a computer program makes a random choice. When comparing two programs, such a tie-break can result in two valid, but different results. This made the validation awkward, since either that election had to be ignored, or one of the programs had to be re-run with the option taken by the other program enforced. In most such elections the results were not compared, and as a result, a small difference between the two programs was not detected. The proposal to resolve tie-breaks by Borda scores would largely avoid this problem[7].

Church of England validation

Since the objective here was to revalidate David Hill's program, little would be gained in repeating the activity undertaken for the first validation. There were two changes to the Church's specification: a small change to rectify the Lichfield anomaly (which influences the main counting logic, see below), and the much larger change to add the handling of constraints. The logic used to handle constraints is specified in *Voting matters*[5].

The testing of the main counting logic relied upon the previous testing and the clearance of the Lichfield anomaly. Also, all the tests run were checked for the correctness of the row and column arithmetic. Hence the main effort was in checking the constraint handling.

The new Church of England rules (GS1327)[6] merely specify the actions to be taken during the count using the concept of candidates which are *doomed* or *guarded*. A doomed candidate is one that cannot be elected if a conformant result is to be obtained. A guarded candidate is one that must be elected if a conformant result is to be obtained. GS1327 does not specify the forms that the constraint might take, although it is understood that David Hill's program provides direct support for the constraints that are actually used by the Church. The program requires that every candidate is a member of one and only one constraint group. The constraints themselves specify the maximum and minimum number in a set of constraint groups.

A concern was that it might be possible to specify some constraints which would cause the program to compute for an effectively unbounded length of time. This does not seem possible, basically because the constraints are linear. However, a test was devised which produced a very large table of potential solutions which caused the program to produce a message that insufficient computer storage was available. David Hill has subsequently modified his program to use a file for the table within the counting process which now handles even this case.

Although the program provides direct support for only one form of constraint, indirect support is provided for a much larger range of constraints. As an example, suppose that the constraint groups are Scottish, English and Welsh. A constraint that is not directly support would be that the number of English elected is greater than the number of Scottish elected. However, the indirect method was capable of handling this case.

The approach to testing constraints was to take some elections from the data base (which are like real elections) and add constraints and then check for a conformant result. It was thought that 13 tests adequately covered the implementation of the constraint logic. It appears that the released program handles constraints which are very much more complex that would arise with Church of England counts.

Lichfield anomaly

A problem arose with the use of previous rules which resulted in the change to the rules even when constraints are not being used. This is called the Lichfield anomaly after the diocese where it arose. A simple test case (based upon an example from David Hill) would be to elect 2 from 5 with the following voting pattern:

```
20 AC
13 B
12 C
 2 DB
 1 EB
```

Under the old rules, even though exclusions were one at a time, A's surplus redistribution would be deferred, because it could not change who were the bottom two. Under the new rules it is not deferred because it could change who is the bottom one.

Old rules

```
A  20  20  Elected
B  13  +1   14  +2   16  Elected
C  12       12           Elected
D   2        2  −2    0
E   1  −1    0
```

New rules

```
A  20 −4  16  Elected
B  13
C  12 +4  16  Elected
D   2
E   1
```

A large election

The original certification of David Hill's program did not cover (as it really should have done) the data preparation side. Hence this time, an effort was made to use and test the input logic of the program. A large election was input, both by use of a text editor, and by use of David Hill's program with all the checking options enabled. The conclusion from this was that double-entry should be used in almost all circumstances, since several data entry errors would otherwise be undetected. On the other hand, the program behaved perfectly. (A few points were noted on the user interface, which has resulted in some improvements to the released version.)

Conclusions

Suitable techniques can be used to check STV software. The results have revealed some defects in the programs involved, which, of course, have been removed. However, in fairness to the authors, it is unclear if any of these defects would have remained undetected. Hence the main gain is additional confidence in the software and a reduced risk that such a program would fail during an actual count.

Copies of the full report on both validations are available from the author. Electronic copies are available by mailing a request to Brian.Wichmann@freenet.co.uk.

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Quota reduction in hand-counting STV rules

I D Hill

The 1997 ERS rules for STV[1] include a rule for reducing the quota if some votes become non-transferable before anyone has been deemed elected. In general, such a rule is to be welcomed, as the smaller the quota can legitimately be made the better.

However, in attempting to implement this rule in my STV computer program I ran into difficulties of interpretation. It may be that the circumstances that cause such difficulty would rarely arise in practice, but that is irrelevant. Rules, and programs derived from them, have to work in all circumstances. I wished to know whether the difficulties were real, or whether I was being over-fussy in imagining them, so I consulted a number of people, chosen as being knowledgeable in STV, and asked for their views on what the rules required with each of four examples. Their replies were sufficiently varied as to show that there is a real problem.

The rules in question are:

> 5.3.1 If a surplus arises at the first stage, select for examination all the papers which the candidate has received.
>
> 5.3.2 If a surplus arises at a later stage, because of the transfer of another surplus or the exclusion of a candidate or candidates, select only the last received batch of papers, which gave rise to the surplus.

With minor changes of wording those two rules are as in the previous edition, but we now also have:

> 5.4.8 If any papers have become non-transferable before any candidate has been deemed elected, recalculate the quota as in paragraph 5.1.6, ignoring the non-transferable vote.

The first three examples were as shown below. The fourth was somewhat different as it did not do what was intended and it is better here to show the intended case instead of the unintended one.

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Election 1  Election 2  Election 3   Election 4
 17 AB..     14 AB..     17 AB..      12 AB..
 11 BC..     11 BC..     11 BC..      11 BC..
 10 CD..     10 CD..     10 CD..      10 CD..
 10 DA..     10 DA..      9 DA..      10 DA..
  6 E(plump)  6 E(plump)  6 E(plump)   6 E(plump)
              3 EAC..     1 EAC..      5 FAD..
```

In each of these there are 2 seats to be filled and 54 votes. In each case the initial quota is 54/3 = 18. In each case 6 votes become non-transferable before any candidate is deemed elected, so the quota is reduced to 48/3 = 16. In each case candidate A now has over a quota of votes. How do the rules require A's surplus to be dealt with?

As a result of the exercise, it seems clear to me that trying to implement these rules would not be sensible until they have been amended for, even in the simplest cases, elections 1 and 2, it is not absolutely clear where A's surplus should go, since it cannot really be said that the papers concerned ‘gave rise to the surplus’. In election 3 there was much disagreement about how much goes to C and how much (if any) to B. If experts disagree, to the extent that was observed, on what the rules mean, what hope is there for an ordinary returning officer?

In election 4 the ‘gave rise to the surplus’ wording is even more far-fetched than in the other cases, and my own view is that this case is not catered for in the rules.

I am grateful for an additional case that was suggested to me later by one of those whom I had consulted:

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Election 5
14 AB..
11 BC..
10 CD..
10 DA..
 3 E (plump)
 6 EAC..
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I would probably have got this one wrong, as my first reaction on seeing it was ‘No problem here’, because A has already got more than the original quota by the time it is known that any votes have become non-transferable, so quota reduction would not apply, but not so. Although exceeding the quota, A is not actually deemed elected (para 5.4.9) until after the quota reduction has been made (para 5.4.8).

My own view is that, in principle, the right way to do such quota reduction is to re-start the election after the reduction, with the equivalent of a new Stage 1, treating all excluded candidates as if withdrawn, but the wording of the current rules does not seem to support that. For the moment what is wanted is the publication of a clarifying amendment to the rules, so that users can know how to proceed. This issue can be resolved only by a properly authorised statement from the ERS Council.

Reference

1. Newland R A and Britton F S. How to conduct an election by the Single Transferable Vote. 3rd edition. Electoral Reform Society. 1997.

The problem of surpluses when the quota is reduced

Colin Rosenstiel

Normally a candidate elected with a quota receives ballot papers at the stage at which their votes first exceed the quota. Since the changes to the rules made in 1997 it is now possible for a candidate to be elected with a surplus at a stage where they receive no ballot papers. If the quota is reduced at the same stage from a larger number than the candidate's current vote to a figure below that vote they can be declared elected with a surplus. It has of course been possible for a candidate to be elected without a surplus at a stage where they receive no ballot papers since the introduction of the second edition of the rules in 1976.

The candidate's surplus does not then arise from papers received at that stage, the rule heretofore. However the principle remains that their surplus is derived only from the last-received parcel of papers, their first preferences if no papers have been received since then. The rules in detail say:

> 5.3 Transfer of a surplus
>
> 5.3.1 If a surplus arises at the first stage, select for examination all the papers which the candidate has received.
>
> 5.3.2 If a surplus arises at a later stage, because of the transfer of another surplus or the exclusion of a candidate or candidates, select only the last received batch of papers, which gave rise to the surplus.

Any difficulty in interpreting this wording is because of the possibility of different interpretations of the term ‘arises’. The candidate declared elected due to the quota being reduced may not have received any papers at the stage in question. I would therefore maintain that only perversity could lead to the conclusion that the word ‘arises’ could refer to any other stage than the one at which the papers were received and that the most recently received parcel of papers should be the ones used to transfer the surplus as has always been the case.

It is also possible for the papers forming a surplus to be worth less than the value of the surplus. This is again not new, in terms of transferable papers, and is to be treated in the same way — no paper may be transferred at a higher value than it had when received by the candidate with the surplus.

In his article Dr Hill[1] gives a number of examples which he claims there are difficulties over interpretation of the rules quoted above. He doesn't explain what the difficulties are. If the precise wording above is not applicable (which I argue above is not the case anyway) what rules does he imagine are to be followed?

There is also a problem about the importance of this supposed difficulty. The figure of 12% of cases is mentioned by the Dr Wichmann[2], though without supporting evidence. His original claim was for 25% of cases but it turns out that half were AV elections where no surplus can ever be transferred!

Bear in mind that the disputed cases require (a) a reduced quota (b) a surplus arising at a stage where the elected candidate receives no papers (c) that surplus to be transferred. Since the rule came in I have counted many elections. Just three had reduced quotas. In no cases did a surplus arise at a stage where a candidate received no votes, let alone such a surplus requiring to be transferred.

References

1. I D Hill. Quota reduction in hand-counting STV rules. *Voting matters*. Issue 11. p9.

2. B A Wichmann. Checking two STV programs. *Voting matters*. Issue 11. pp6-8.

Brian Wichmann responds

Colin Rosenstiel correctly quotes my article which on reflection might be confusing. The 25% refers to those elections in which, logically, quota reduction takes place. The 12% refers to those elections in which subsequent transfers take place. Nobody knows what fraction of the 12% are truly ‘ambiguous’ in the sense raised by David Hill. I would regard any significant percentage as quite unacceptable, since surely STV should be no less certain that First Past The Post. To avoid any problems, I would suggest that the Council of the ERS formally accepts a small wording change proposed by Colin Rosenstiel in a letter to David Hill dated 8th November 1998.