## Part 3 of 5:

# Implementing the Schulze STV Method

(draft, 4 April 2011)

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**Summary.** In this paper the Schulze STV method with proportional completion is applied to instance A53 of Tideman's database.

This paper is the third part of a series of papers that can be downloaded here:

http://m-schulze.webhop.net/schulze1.pdf
http://m-schulze.webhop.net/schulze2.pdf
http://m-schulze.webhop.net/schulze3.zip
http://m-schulze.webhop.net/schulze4.pdf
http://m-schulze.webhop.net/schulze5.pdf

Instance A53 consists of $N = 460$ voters and $C = 10$ candidates running for $M = 4$ seats. This instance is very interesting because the Newland-Britton method, the Meek method, and the Warren method each chooses a different set of winners. The Newland-Britton (1997) method chooses {*a*,*b*,*g*,*j*}; the Meek (1969, 1970; Hill, 1987) method chooses {*a*,*d*,*g*,*j*}; and the Warren (1994) method chooses {*a*,*f*,*g*,*j*}.

**Format 1:**

The instances of Tideman’s database have two different formats. 50 of the 66 instances of Tideman’s database have format “1”. For example, instance A53 shares this format. That means, the file *a53.dat* has to be read as follows:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 353 | 3 | 99 | 99 | 99 | 4 | 99 | 2 | 99 | 99 | 1 |

The first column is the number of the voter. The second to the eleventh column are the preferences of voter $v = 353$ for candidate *a* to candidate *j*. Thus, voter $v = 353$ gives his first preference to candidate *j*, his second preference to candidate *g*, his third preference to candidate *a*, and his fourth preference to candidate *e*. And he keeps the candidates *b*, *c*, *d*, *f*, *h*, and *i* unranked.

**Format 2:**

16 of the 66 instances of Tideman’s database have format “2”. For example, instance A35 shares this format. That means, the file *a35.dat* has to be read as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 26 | F | D | O | N | P | H | A |

Voter $v = 26$ gives his first preference to candidate *f*, his second preference to candidate *d*, his third preference to candidate *o*, his fourth preference to candidate *n*, his fifth preference to candidate *p*, his sixth preference to candidate *h*, and his seventh preference to candidate *a*. And he keeps the candidates *b*, *c*, *e*, *g*, *i*, *j*, *k*, *l*, *m*, and *q* unranked.

Unfortunately, in 7 instances some voters give more than one preference to the same candidate. The following table lists all those voters who give more than one preference to the same candidate:

| instance | voters who give more than one preference to the same candidate |
|---|---|
| A17 | #72, #126, #152, #232, #275, #290, #370, #538, #793, #846 |
| A19 | #330, #816 |
| A20 | #98, #1783, #2193, #2221 |
| A49 | #16, #51, #133, #134, #315, #413, #463, #559 |
| A83 | #69, #85, #145, #205, #317, #757,<br>#782, #802, #1001, #1046, #1088 |
| A95 | #267 |
| A96 | #415 |

When an individual voter ranks some candidates in a cyclic manner, then we presume that this voter is indifferent between all the candidates of this cycle.

File *a53_stv.dat* contains the strengths of the $(C!)/((M!)\cdot((C–M–1)!)) = 1260$ vote managements. File *a53_stv.dat* has to be read as follows:

| 104 | A | D | F | G | J | 88.714286 | 101.098901 | 101.351648 | 90.736264 | 78.098901 |
|---|---|---|---|---|---|---|---|---|---|---|

Then, row 104 says:

$N[\{d,f,g,j\},a] = 88.714286$

$N[\{a,f,g,j\},d] = 101.098901$

$N[\{a,d,g,j\},f] = 101.351648$

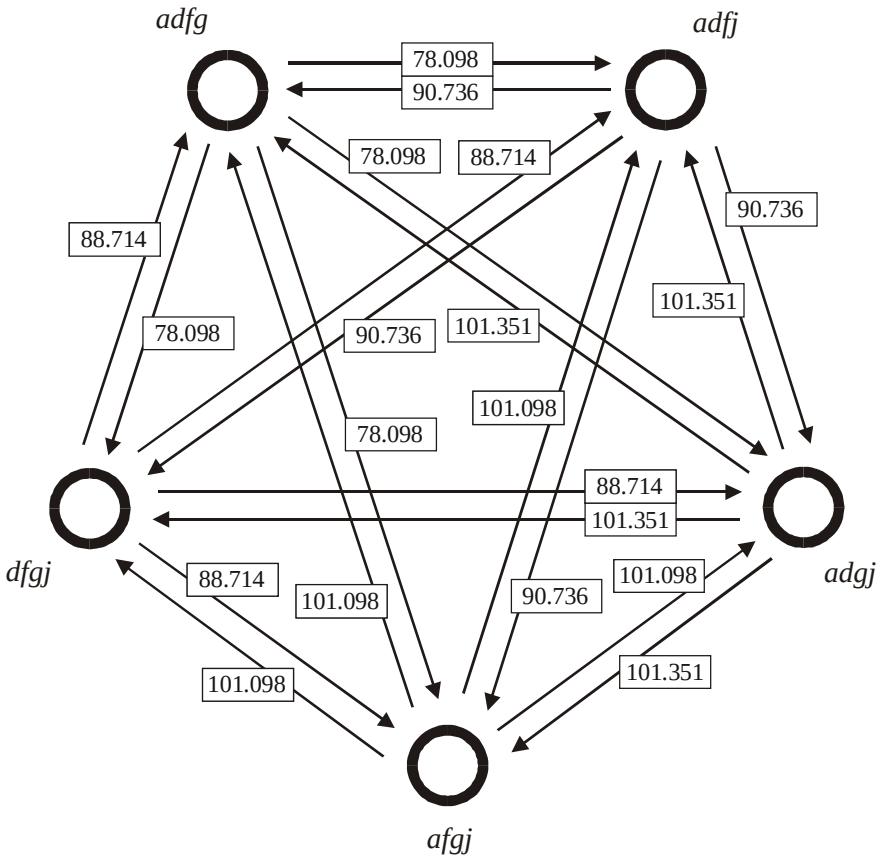
$N[\{a,d,f,j\},g] = 90.736264$

$N[\{a,d,f,g\},j] = 78.098901$

In the traditional head-to-head format, row 104 represents the following defeats:

| | $\tilde{N}[*,\{adfg\}]$ | $\tilde{N}[*,\{adfj\}]$ | $\tilde{N}[*,\{adgj\}]$ | $\tilde{N}[*,\{afgj\}]$ | $\tilde{N}[*,\{dfgj\}]$ |
|---|---|---|---|---|---|
| $\tilde{N}[\{adfg\},*]$ | --- | 78.098901 | 78.098901 | 78.098901 | 78.098901 |
| $\tilde{N}[\{adfj\},*]$ | 90.736264 | --- | 90.736264 | 90.736264 | 90.736264 |
| $\tilde{N}[\{adgj\},*]$ | 101.351648 | 101.351648 | --- | 101.351648 | 101.351648 |
| $\tilde{N}[\{afgj\},*]$ | 101.098901 | 101.098901 | 101.098901 | --- | 101.098901 |
| $\tilde{N}[\{dfgj\},*]$ | 88.714286 | 88.714286 | 88.714286 | 88.714286 | --- |

In the graph theoretical format, row 104 represents the following links:



Candidates *a*, *g*, and *j* are Condorcet candidates because the strongest vote managements against these candidates are strictly below $N/(M+1) = 92$.

$$\max \{ N[\{z_1,...,z_4\},a] \mid z_1,...,z_4 \in A \setminus \{a\} \} = 89.332604$$

$$\max \{ N[\{z_1,...,z_4\},g] \mid z_1,...,z_4 \in A \setminus \{g\} \} = 91.345733$$

$$\max \{ N[\{z_1,...,z_4\},j] \mid z_1,...,z_4 \in A \setminus \{j\} \} = 78.524229$$

When the Schulze STV method with proportional completion is being used, then $\mathfrak{A} = \{a,f,g,j\}$ is the unique winning set, since it is the only set with $P[\mathfrak{A},\mathfrak{B}] \geq P[\mathfrak{B},\mathfrak{A}]$ for every other set $\mathfrak{B} \in A_4$.

The largest value in file *a53_stv.dat* is $N[\{a,e,g,j\},h] = 110.674779$. This is the strength of the vote management of the candidates $\{a,e,g,j\}$ against candidate *h*. This vote management is illustrated in table 1.

In table 1, the column “opinion” describes the opinion of the voters. A “1” means that this voter strictly prefers this candidate to candidate *h*. A “2” means that this voter is indifferent between this candidate and candidate *h*. A “3” means that this voter strictly prefers candidate *h* to this candidate. The column “voters #1” says how many voters share this opinion *before* proportional completion. The column “voters #2” says how many voters share this opinion *after* proportional completion. The column “distribution” describes how many voters of each group of voters vote for which candidate in the optimal vote management of the candidates in columns “1”, “2”, “3”, and “4” against the candidate in column “5”.

For example, row “4” says that *before* proportional completion there are 8 voters and *after* proportional completion there are 9.210514 voters who strictly prefer the candidates *a* and *e* to candidate *h* and who strictly prefer candidate *h* to the candidates g and *j*. In the optimal vote management of the candidates $\{a,e,g,j\}$ against candidate *h*, all 9.210514 voters vote for candidate *e*.

| | opinion | | | | voters | voters | distribution | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | #1 | #2 | 1 | 2 | 3 | 4 | 5 |
| | *a* | *e* | *g* | *j* | | | *a* | *e* | *g* | *j* | *h* |
| 1 | 1 | 1 | 1 | 1 | 76 | 174.783852 | 26.529814 | 42.206980 | 79.076900 | 26.970159 | |
| 2 | 1 | 1 | 1 | 3 | 7 | 11.478359 | | 11.478359 | | | |
| 3 | 1 | 1 | 3 | 1 | 18 | 29.690120 | | 29.690120 | | | |
| 4 | 1 | 1 | 3 | 3 | 8 | 9.210514 | | 9.210514 | | | |
| 5 | 1 | 3 | 1 | 1 | 23 | 60.086335 | 60.086335 | | | | |
| 6 | 1 | 3 | 1 | 3 | 7 | 10.278434 | 10.278434 | | | | |
| 7 | 1 | 3 | 3 | 1 | 30 | 40.043541 | | | | 40.043541 | |
| 8 | 1 | 3 | 3 | 3 | 13 | 13.780196 | 13.780196 | | | | |
| 9 | 3 | 1 | 1 | 1 | 8 | 16.563163 | | | 16.563163 | | |
| 10 | 3 | 1 | 1 | 3 | 3 | 4.586022 | | 4.586022 | | | |
| 11 | 3 | 1 | 3 | 1 | 6 | 8.113086 | | 8.113086 | | | |
| 12 | 3 | 1 | 3 | 3 | 5 | 5.389698 | | 5.389698 | | | |
| 13 | 3 | 3 | 1 | 1 | 8 | 13.449067 | | | | 13.449067 | |
| 14 | 3 | 3 | 1 | 3 | 14 | 15.034716 | | | 15.034716 | | |
| 15 | 3 | 3 | 3 | 1 | 28 | 30.212012 | | | | 30.212012 | |
| 16 | 3 | 3 | 3 | 3 | 17 | 17.300885 | | | | | 17.300885 |
| 17 | 1 | 1 | 1 | 2 | 3 | | | | | | |
| 18 | 1 | 1 | 2 | 1 | 8 | | | | | | |
| 19 | 1 | 1 | 2 | 2 | 5 | | | | | | |
| 20 | 1 | 2 | 1 | 1 | 32 | | | | | | |
| 21 | 1 | 2 | 1 | 2 | 17 | | | | | | |
| 22 | 1 | 2 | 2 | 1 | 26 | | | | | | |
| 23 | 1 | 2 | 2 | 2 | 8 | | | | | | |
| 24 | 2 | 1 | 1 | 1 | 11 | | | | | | |
| 25 | 2 | 1 | 1 | 2 | 11 | | | | | | |
| 26 | 2 | 1 | 2 | 1 | 8 | | | | | | |
| 27 | 2 | 1 | 2 | 2 | 6 | | | | | | |
| 28 | 2 | 2 | 1 | 1 | 20 | | | | | | |
| 29 | 2 | 2 | 1 | 2 | 11 | | | | | | |
| 30 | 2 | 2 | 2 | 1 | 14 | | | | | | |
| 31 | 2 | 2 | 2 | 2 | 8 | | | | | | |
| 32 | 2 | 3 | 3 | 1 | 1 | | | | | | |
| sum | | | | | 460 | 460 | 110.674779 | 110.674779 | 110.674779 | 110.674779 | 17.300885 |

Table 1: vote management of the candidates {*a*,*e*,*g*,*j*} against candidate *h*

In table 2, the Schulze STV method is applied to other instances of Tideman’s (2000) database. The column “name 1” contains the name of the instance. If e.g. the name of the instance is A53, then the file *a53.dat* contains the raw data of this instance, the file *a53_stv.dat* contains the strengths of the vote managements to calculate the winning set of the Schulze STV method, and *a53_list.dat* contains the strengths of the vote managements to calculate the Schulze proportional ranking.

The column “name 2” contains the name of the same instance in Wichmann’s (1994) database. *N* is the number of voters. *C* is the number of candidates. *M* is the number of seats.

The column “Schulze STV” contains the winning set of the Schulze STV method with proportional completion. The column “Schulze proportional ranking” contains the Schulze proportional ranking. Only in 3 of the 66 instances of Tideman’s database (A10, A13, A34), the winning set of the Schulze STV method differs from the first *M* candidates of the Schulze proportional ranking.

The programs *single01.c* and *multi01.c* calculate the winning set of the Schulze STV method. The program *single01.c* is single-threading; the program *multi01.c* is multi-threading. The column “runtime 1” contains the runtime for *single01.c*. The column “runtime 2” contains the runtime for *multi01.c*. An Intel Pentium 4 with two processors with 1.5 GHz each is used for the calculations.

The programs *single02.c* and *multi02.c* calculate the Schulze proportional ranking.

| | name 1 | name 2 | *N* | *C* | *M* | Schulze STV | Schulze proportional ranking | runtime 1 | runtime 2 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A01 | R006 | 380 | 10 | 3 | *a h i* | *a i h d c b g j f e* | 0.2 s | < 0.1 s |
| 2 | A02 | R007 | 371 | 9 | 2 | *c d* | *c d e f b a h i g* | < 0.1 s | < 0.1 s |
| 3 | A03 | R008 | 989 | 15 | 7 | *b d e f h k n* | *f h d k e b n a g l c i j o m* | 272.2 s | 197.2 s |
| 4 | A04 | R009 | 43 | 14 | 2 | *a i* | *i a k f e c b g d h m j l n* | 0.2 s | < 0.1 s |
| 5 | A05 | R010 | 762 | 16 | 7 | *a c d e g l m* | *a c m e d g l k f p o h i j b n* | 427.1 s | 310.9 s |
| 6 | A06 | R011 | 280 | 9 | 5 | *b c e h i* | *i h e c b f g a d* | 0.2 s | < 0.1 s |
| 7 | A07 | R012 | 79 | 17 | 2 | *d i* | *i d c m o p h k a g e j l n f b q* | 0.5 s | < 0.1 s |
| 8 | A08 | R013 | 78 | 7 | 2 | *d g* | *d g c b f e a* | < 0.1 s | < 0.1 s |
| 9 | A10 | R015 | 83 | 19 | 3 | *m n p* | *n ( a p m q )* or *( m p q a ) f g r s l i b d j k e h o c* | 3.6 s | 0.9 s |
| 10 | A11 | R016 | 963 | 10 | 6 | *a c d e h j* | *a c h e j d i g b f* | 1.2 s | 0.8 s |
| 11 | A12 | R017 | 76 | 20 | 2 | *i r* | *r i l s g m a p b t h n e o k d ( f j )* or *( j f ) c q* | 0.7 s | 0.2 s |
| 12 | A13 | R018 | 104 | 26 | 2 | *k t* | *i t k m s j c f y z l u a g e n b p d h v x o r q w* | 1.7 s | 0.5 s |
| 13 | A14 | R019 | 73 | 17 | 2 | *b j* | *j b c n h q o a e d g l i k p m f* | 0.4 s | < 0.1 s |
| 14 | A15 | R020 | 77 | 21 | 2 | *l r* | *l r i m h c p j k s a t q g b o d u n f e* | 0.9 s | 0.3 s |
| 15 | A17 | R022 | 867 | 13 | 8 | *a b d e f i j l* | *j b a e f l i d m h k c g* | 26.2 s | 20.8 s |
| 16 | A18 | R023 | 976 | 6 | 4 | *a b c f* | *b c f a d e* | < 0.1 s | < 0.1 s |
| 17 | A19 | R024 | 860 | 7 | 3 | *a e g* | *e a g c d b f* | < 0.1 s | < 0.1 s |
| 18 | A20 | R025 | 2785 | 5 | 4 | *a c d e* | *a d c e b* | < 0.1 s | < 0.1 s |
| 19 | A22 | R027 | 44 | 11 | 2 | *c k* | *k c a g b d i j h e f* | < 0.1 s | < 0.1 s |
| 20 | A23 | R028 | 91 | 29 | 2 | 3, 5 | 3 5 7 21 26 22 17 27 9 15 14 ( 4 19 ) or ( 19 4 ) 24 6 11 28 20 2 23 29 16 18 1 13 8 10 12 25 | 2.4 s | 0.6 s |

| | name 1 | name 2 | *N* | *C* | *M* | Schulze STV | Schulze proportional ranking | runtime 1 | runtime 2 |
|---|---|---|---|---|---|---|---|---|---|
| 21 | A33 | R038 | 9 | 18 | 3 | *e n o* | *o e n* ... | 2.6 s | 0.6 s |
| 22 | A34 | R039 | 63 | 14 | 12 | *a b c d e f g h j k m n* | *j b h e n k l m c a d f g i* | < 0.1 s | < 0.1 s |
| 23 | A35 | R040 | 176 | 17 | 5 | *a d e f q* | *f e a q d k b m i n c j h p o g l* | 57.1 s | 35.8 s |
| 24 | A48 | R041 | 923 | 10 | 9 | *a b c d e f g h j* | *d f b e c h j g a i* | < 0.1 s | < 0.1 s |
| 25 | A49 | R042 | 575 | 13 | 3 | *a c h* | *h c a j l d m g b i e f k* | 0.9 s | 0.4 s |
| 26 | A51 | R044 | 42 | 6 | 3 | *a d e* | *d a e f c b* | < 0.1 s | < 0.1 s |
| 27 | A52 | R045 | 667 | 10 | 6 | *a b c d e g* | *e d b g a c j f i h* | 0.9 s | 0.6 s |
| 28 | A53 | R046 | 460 | 10 | 4 | *a f g j* | *j a g f d b e c i h* | 0.5 s | 0.3 s |
| 29 | A54 | R047 | 924 | 11 | 9 | *a b d e f g h j k* | *e d f a k g h b j i c* | 0.7 s | 0.6 s |
| 30 | A55 | R048 | 302 | 10 | 5 | *a e f i j* | *i a f j e d c h g b* | 0.6 s | 0.3 s |
| 31 | A56 | R049 | 685 | 13 | 2 | *j k* | *j k f h m g d a e c b l i* | 0.2 s | < 0.1 s |
| 32 | A57 | R050 | 310 | 9 | 2 | *d e* | *d e i b h c g f a* | < 0.1 s | < 0.1 s |
| 33 | A59 | R052 | 694 | 7 | 4 | *d e f g* | *f d e g b c a* | < 0.1 s | < 0.1 s |
| 34 | A63 | R056 | 156 | 7 | 2 | *c f* | *c f e d b a g* | < 0.1 s | < 0.1 s |
| 35 | A64 | R057 | 196 | 3 | 2 | *b c* | *b c a* | < 0.1 s | < 0.1 s |
| 36 | A65 | R058 | 198 | 10 | 6 | *a b e f g j* | *g b f e j a d h c i* | 1.1 s | 0.8 s |
| 37 | A66 | R059 | 193 | 6 | 4 | *b d e f* | *f d e b c a* | < 0.1 s | < 0.1 s |
| 38 | A67 | R060 | 183 | 14 | 10 | *b c e f g h i j k l* | ( *f g* ) or ( *g f* ) *k b i e j l c h n m d a* | 468.1 s | 367.3 s |
| 39 | A68 | R061 | 50 | 4 | 3 | *a c d* | *a c d b* | < 0.1 s | < 0.1 s |
| 40 | A69 | R062 | 86 | 9 | 3 | *a c e* | *e c a f i d b h g* | < 0.1 s | < 0.1 s |

| | name 1 | name 2 | *N* | *C* | *M* | Schulze STV | Schulze proportional ranking | runtime 1 | runtime 2 |
|---|---|---|---|---|---|---|---|---|---|
| 41 | A70 | R063 | 529 | 9 | 3 | *e h i* | *e i h c d b a g f* | < 0.1 s | < 0.1 s |
| 42 | A71 | R064 | 500 | 8 | 7 | *a b c d e f g* | *d g c e a b f h* | < 0.1 s | < 0.1 s |
| 43 | A72 | R065 | 272 | 3 | 2 | *a c* | *a c b* | < 0.1 s | < 0.1 s |
| 44 | A73 | R066 | 525 | 5 | 2 | *c d* | *d c b a e* | < 0.1 s | < 0.1 s |
| 45 | A74 | R067 | 253 | 3 | 2 | *a c* | *a c b* | < 0.1 s | < 0.1 s |
| 46 | A76 | R069 | 403 | 5 | 2 | *a c* | *c a d b e* | < 0.1 s | < 0.1 s |
| 47 | A78 | R071 | 486 | 4 | 3 | *b c d* | *c d b a* | < 0.1 s | < 0.1 s |
| 48 | A79 | R072 | 362 | 8 | 4 | *a c e g* | *g a e c f d b h* | < 0.1 s | < 0.1 s |
| 49 | A80 | R073 | 269 | 7 | 5 | *a b c e g* | *a e c g b f d* | < 0.1 s | < 0.1 s |
| 50 | A81 | R074 | 902 | 11 | 9 | *a b c e g h i j k* | *h e c b j g a i k d f* | 1.0 s | 0.8 s |
| 51 | A83 | R076 | 1123 | 4 | 3 | *a b c* | *c a b d* | < 0.1 s | < 0.1 s |
| 52 | A84 | R077 | 277 | 7 | 6 | *a b c d e g* | *e b c g d a f* | < 0.1 s | < 0.1 s |
| 53 | A85 | R078 | 158 | 4 | 3 | *a b d* | *d a b c* | < 0.1 s | < 0.1 s |
| 54 | A86 | R079 | 157 | 5 | 4 | *a c d e* | *c a d e b* | < 0.1 s | < 0.1 s |
| 55 | A87 | R080 | 120 | 4 | 3 | *a b d* | *d b a c* | < 0.1 s | < 0.1 s |
| 56 | A88 | R081 | 135 | 9 | 6 | *a c e f g h* | *h e g c f a d b i* | 0.2 s | < 0.1 s |
| 57 | A89 | R082 | 256 | 5 | 3 | *a d e* | *e d a b c* | < 0.1 s | < 0.1 s |
| 58 | A90 | R083 | 366 | 20 | 12 | *a b c d e f i l n o s t* | *a i t l e c f d s n o b j p m k r g h q* | 4,089.0 s | 3,192.3 s |
| 59 | A92 | R085 | 540 | 13 | 3 | *d f i* | *d f i e b h a m c j g k l* | 0.8 s | 0.3 s |
| 60 | A93 | R086 | 561 | 4 | 2 | *b d* | *b d c a* | < 0.1 s | < 0.1 s |
| 61 | A94 | R087 | 579 | 4 | 2 | *a d* | *a d b c* | < 0.1 s | < 0.1 s |
| 62 | A95 | R088 | 587 | 7 | 2 | *a b* | *a b f g d e c* | < 0.1 s | < 0.1 s |
| 63 | A96 | R089 | 564 | 6 | 2 | *a b* | *a b e f d c* | < 0.1 s | < 0.1 s |
| 64 | A97 | R090 | 284 | 4 | 2 | *a b* | *a b c d* | < 0.1 s | < 0.1 s |
| 65 | A98 | R091 | 279 | 4 | 2 | *a c* | *a c b d* | < 0.1 s | < 0.1 s |
| 66 | A99 | R092 | 275 | 4 | 2 | *a b* | *b a c d* | < 0.1 s | < 0.1 s |

Table 2: Schulze STV method applied to instances of Tideman’s database

In 19 of the 66 instances of Tideman’s database, the winning set of the Schulze STV method differs from the winning set of traditional STV methods. These instances are listed in table 3. The column “Newland-Britton” contains the winning set of the Newland-Britton (1997) method. The column “Meek” contains the winning set of the Meek (1969, 1970; Hill, 1987) method. The column “Warren” contains the winning set of the Warren (1994) method.

| | name 1 | name 2 | *N* | *C* | *M* | Newland-Britton | Meek | Warren | Schulze STV |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A04 | R009 | 43 | 14 | 2 | *a i* | *i k* | *i k* | *a i* |
| 2 | A05 | R010 | 762 | 16 | 7 | *a c d e g k m* | *a c d e g k m* | *a c d e g k m* | *a c d e g l m* |
| 3 | A06 | R011 | 280 | 9 | 5 | *c e f h i* | *c e f h i* | *c e f h i* | *b c e h i* |
| 4 | A07 | R012 | 79 | 17 | 2 | *c i* | *c i* | *c i* | *d i* |
| 5 | A11 | R016 | 963 | 10 | 6 | *a c e g h i* | *a c e g h i* | *a c e g h i* | *a c d e h j* |
| 6 | A15 | R020 | 77 | 21 | 2 | *l r* | *i l* | *i l* | *l r* |
| 7 | A33 | R038 | 9 | 18 | 3 | [1] | [1] | [1] | *e n o* |
| 8 | A34 | R039 | 63 | 14 | 12 | *a b c d e f h j k l m n* | *a b c d e f h j k l m n* | *a b c d e f h j k l m n* | *a b c d e f g h j k m n* |
| 9 | A35 | R040 | 176 | 17 | 5 | *a e f n q* | *a e f k n* | *a e f k n* | *a d e f q* |
| 10 | A53 | R046 | 460 | 10 | 4 | *a b g j* | *a d g j* | *a f g j* | *a f g j* |
| 11 | A55 | R048 | 302 | 10 | 5 | *a d f i j* | *a d e f i* | *a d e f i* | *a e f i j* |
| 12 | A59 | R052 | 694 | 7 | 4 | *b d f g* | *b d f g* | *b d f g* | *d e f g* |
| 13 | A65 | R058 | 198 | 10 | 6 | *b d e f g j* | *b d e f g j* | *b d e f g j* | *a b e f g j* |
| 14 | A67 | R060 | 183 | 14 | 10 | *b c d e f g i j k l* | *b c d e f g h i j k* | *b c d e f g i j k l* | *b c e f g h i j k l* |
| 15 | A71 | R064 | 500 | 8 | 7 | *a b c d e g h* | *a b c d e g h* | *a b c d e g h* | *a b c d e f g* |
| 16 | A74 | R067 | 253 | 3 | 2 | *a b* | *a b* | *a b* | *a c* |
| 17 | A79 | R072 | 362 | 8 | 4 | *a e f g* | *a d e g* | *a d e g* | *a c e g* |
| 18 | A80 | R073 | 269 | 7 | 5 | *a b c e f* | *a b c e f* | *a b c e f* | *a b c e g* |
| 19 | A90 | R083 | 366 | 20 | 12 | *a b c d e f i k l n s t* | *a b c d e f i k l n s t* | *a b c d e f i l n o s t* | *a b c d e f i l n o s t* |

Table 3: instances where the winning set of the Schulze STV method differs from the winning set of traditional STV methods

[1] In instance A33, 10 candidates received no first preferences, 7 candidates received one first preference each, and one candidate received two first preferences. The winning sets of the Newland-Britton method, the Meek method, and the Warren method depend on which candidates happen to be eliminated by random choice. The Schulze STV method chooses the candidates *e*, *n*, and *o* who received no first preference resp. one first preference resp. two first preferences.

## Acknowledgments

I want to thank Nic Tideman for giving me access to his database and for sending me a preprint of his paper “Better voting methods through technology”.

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