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PREFERENCE COUNTING IN LOCAL GOVERNMENT ELECTIONS IN NSW

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Inquiry into Counting at NSW Local Government Elections.

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What is the NSW Local Government's Electoral System?

For both Legislative Council and Local Government elections, NSW counts votes using a variant of Proportional Representation by Single Transferrable Vote (PR-STV). The system elects multiple members from a given electorate by a combination of quotas and preferences, electing members that the counting system determines to be the most preferred candidates.

PR-STV has its origins in the work of Thomas Hare in the United Kingdom in the mid-19th century. He designed his STV counting system not as a form of proportional representation, but as a mechanism to minimise the number of 'wasted' votes. Hare defined wasted votes as votes that did not contribute to the election of a representative.

The political world of Hare's day pre-dated rigidly organised political parties. It was closer to some of today's NSW councils where elections are conducted without groups and parties. Hare's STV counting method worked to elect the group of candidates that were the most preferred and minimised the number of wasted votes.

STV becomes PR-STV when we deal with elections that involve parties and groups. Proportionality only makes sense when there are parties or groups, where representation can viewed as being allocated proportional to party vote.

The Quota under PR-STV.

To be elected under PR-STV, a candidate must achieve a quota of votes. The quota used in Australia is known as a 'Droop' quota, named after lawyer and mathematician Henry Richmond Droop. He proposed his quota as a better alternative to Hare's original method.

The formula is

Droop Quota = [Integer part of Total Votes divided by (Number of Vacancies + 1)] + 1

For an election with 10,001 formal ballot papers and three vacancies to fill, the quota would be

Quota = Integer part of [(10,001 / (3 + 1)] + 1
= Integer part of (2,500.25) + 1
= 2,501

If three candidates were elected with filled quotas at the above election, they would possess 7,503 votes or more, meaning the number of votes remaining with unelected candidates must be less than the quota.

Preferential Voting in Single Member Electorates as a Special Case of STV

Preferential voting in single member electorates is a special case of the STV voting system. The number of vacancies is 1, so using the 10,001 vote example above, the quota for election would be 5,001. An elected candidate with a quota of votes would also have a majority of votes.

How Quotas are Filled

Candidates achieve a quota of votes under the PR-STV by gaining votes from three sources -

(1) From first preferences votes cast for the candidate. I will refer to these in this paper **First Preference votes**.
(2) From votes transferred as further preferences from excluded candidates. I will refer to these as **Excluded Candidate Preferences**.
(3) From votes transferred from the surplus votes of candidates that have achieved a quota. I will refer to these as **Surplus to Quota Preferences**.

Vote sources (1) and (2) are the same as how votes are accumulated under single member preferential voting. As a noted above, single member STV counting is a special case of PR-STV.

The third category of surplus to quota preferences only exists in the world of multi-member STV. When a candidate is declared elected and has a surplus of votes in excess of the quota, and vacancies remain to be filled, then the candidate's surplus to quota votes are distributed. Under STV rules, the distribution of surplus to quota preferences generally takes place before the distribution of preferences from excluded candidates.

Dealing with preferences from surplus to quota votes creates three questions -

(1) At what value should preferences/ballot papers be distributed? Should exhausting preferences be included or excluded from the calculations and distribution?
(2) Which ballot papers should be examined to determine preferences? Should only the votes that put the candidate over the quota be examined, or should all votes held by the candidate be included?
(3) What is the size of the surplus? Should the distribution of excluded candidates be bundled or segmented to change the size of the surplus of elected candidates?

The different answers available to these three questions help explain the variation in PR-STV methods used across Australia.

What is a Transfer Value?

A Transfer Value defines the relationship between a 'vote' and a 'ballot paper' and is used to allow the distribution of surplus to quota preferences from candidates with more than a quota of votes.

The relationship between Votes and Ballot Papers is defined as -

A Vote = a Ballot Paper multiplied by its Transfer Value

A total of votes = the total of ballot papers multiplied by their Transfer Value.

In a single member electorate count, one vote always equals one ballot paper. All ballot papers are transferred at full value, so the Transfer Value is always equal to 1. Under PR-STV, ballot papers at a fraction of full value can enter the count when distributing surplus to quota votes as preferences.

There are several different versions of Transfer Value and these depend on the answers chosen for the three questions I outlined in the previous section.

To explain how transfer values work, let me use the simplest definition of Transfer Value, the one generally used where a candidate achieves a surplus on first preferences. This formula in two parts is

Surplus Votes = Total Votes - Quota

Transfer Value = Surplus Votes / Total Votes

If a candidate attracts 1,250 first preference votes at an election where the quota is 1,000 votes, then the candidate has a filled quota of 1,000 votes and a surplus of 250 votes.

The simple transfer value would be 250 / 1,250 = 0.2000

This transfer value is sometimes expressed as a percentage, so 0.2 becomes 20% .

The Transfer Value can then be used in two different ways. It can be used either to -

(1) randomly select 20% (250) ballot papers from all ballot papers held by the candidate, or
(2) transfer all 1,250 ballot papers at reduced vote value equal to the transfer value 0.2000

Under random sampling (option 1), the transfer value is used to determine the number of ballot papers, and then those ballot papers are distributed as preferences with Transfer Value = 1.

Under option (2), all ballot papers are distributed, but these ballot papers are multiplied by transfer value 0.2000 to give a vote value.

Why Does NSW Use Random Sampling?

Random sampling is used to simplify a manual count. When random sampling is used, the transfer value is calculated to determine the number of full value ballot papers to transfer from a surplus. After the transfer value has been applied to select the sample, it is not transferred with the ballot papers. After the sample is done, all ballot papers are transferred at full vote value.

When using random sampling, at every stage of the count, all ballot papers have the same transfer of 1. There is no need to keep track of fractional transfer values attached to ballot papers. Random sampling means that, as in single member counts, the terms ballot paper and vote can be used interchangeably without reference to transfer value.

It also means that ballot papers not selected to be part of a surplus can be set aside with the elected candidate as their quota. These ballot papers do not need to be examined again, another simplification useful for use in a manual counting process.

All ballot papers held by a candidate at any point in the count have the same value, whether originally derived as First Preference Votes, Excluded Candidate Preferences, or Surplus to Quota Preferences.

If a candidate is excluded, all their votes have the same transfer value and can be distributed in one distribution. Unlike under fractional transfer systems, there is no question of excluding and distributing preferences in different bundles and in different orders.

What are the Problems with Random Sampling?

The answer is repeatability. If the count in a close contest were re-conducted, then even if exactly the same ballot papers were used, then there is a chance that slight differences in the random sample of ballot papers when distributing surplus to quota votes could change the result.

Such a changed outcome would come about not through any choice of a voter, but simply through the process of random sampling surplus to quota votes.

The NSW local government counting system was designed as a one pass counting system. If you have established the first preference votes in the count, and you apply the sampling procedures correctly, then the count can only be re-done on the basis there is a dispute over the formality of the ballot papers.

Under the NSW system, a close result after preferences should of itself not trigger a re-count, as the process of re-sampling could change the result as much as the re-count.

Computerising the Count

NSW computerised counting procedures were adopted largely to ensure that random sampling was done correctly and could pass a legal test of being a random sample. The introduction of 'above the line' voting reduced the number of different preference sequences completed on ballot papers, making the need for a correct random sample more important.

Computerised counting is ideal for producing accurate and repeatable counts. However, if the law specifies that random sampling must be used, then the count can only be accurate. It will not necessarily be repeatable.

The justification for random sampling is it can simplify the handling of a manual count. If computers are now being used to conduct the count, then there is no longer any justification for using random sampling.

If random sampling were abandoned, then NSW counting could be conducted using fractional transfer methods. Rather than random sampling, all ballot papers would be transferred at fractional value, making the count both accurate and repeatable.

If any re-count were conducted under fractional transfer methods, then any change in result would be due to changes in the ballot papers and preferences included in the count, not due to the ballot papers included in a sample.

Now that computers are being used to conduct all PR-STV counts in NSW, there is no justification for continuing with random sampling.

If Random Sampling Were Abandoned, Could the Count Still be Conducted under Current Rules?

Yes, with some minor modification. Rather than transfer values being used as the basis of sampling ballot papers to be distributed, all ballot papers would be transferred at fraction transfer value. All ballot papers are transferred, but their value as votes is reduced by applying the transfer value.

With fractional transfers, ballot papers are never set aside as finally dealt with. They continue in the count at a reduced transfer value.

The current NSW counting procedure uses the **'Gregory' or 'last bundle' method** to determine which votes are examined to determine the preferences for distribution.

When a candidate passes the quota, the only votes examined for preferences are those passed to the candidate in the last bundle of votes. Votes held by the candidate before the last bundle was transferred are not examined.

This is the same method used in the ACT with its computerised count. The ACT also uses the same transfer value formula as NSW in excluding exhausted preferences in calculating transfer value. The ACT system is proof that NSW could abandon random sampling and continue with the same counting system.

Tasmania also uses the 'last bundle' method, but does not exclude exhausted preferences in the transfer value formula. Tasmania has been conducting its PR-STV counts by hand without random sampling for more than a century.

The random sampling method simplifies the count by ensuring all votes in the count have the same transfer value = 1. Using fractional transfers means that not all ballot papers in the count have the same value. This has implications for distributing the preferences of excluded candidates. I will return to this subject under the heading ' Bundling or Segmenting the Count'.

While the ACT example shows that abandoning random sampling in computer counts is easy, there are differences between the NSW, ACT and Tasmanian systems, and the related systems used to elect the Senate and interstate Legislative Councils.

Most of these differences concern the bundling or segmenting of excluded candidates, and also by looking at all votes held by a candidate at the point of passing the quota, rather than just looking at the last bundle.

Should Exhausting Votes be Included When Calculating Transfer values?

Like NSW, the ACT and Tasmania use the Gregory or Last Bundle method in determining which votes to examine to distribute preferences. The difference is that NSW and the ACT first exclude all ballot papers that exhaust at the next preference before calculating the transfer value.

All three systems start with the same definition of Vote Surplus.

Vote Surplus = Total Votes – Quota Value

In Tasmania the Transfer Value is then

Transfer Value = Vote Surplus / Last Votes Received

In the case of a candidate elected on first preferences, the last votes received is the total of first preference votes.

In NSW and the ACT, ballot papers exhausting at the next preference are first excluded before calculating the Transfer Value. In NSW and the ACT the formula is

Transfer Value = Vote Surplus / (Last Votes Received – Exhausting Ballot Papers)
= Vote Surplus / (Votes with continuing preferences)

Exhausted preferences means that the size of the vote surplus may be greater than the number of votes with continuing preferences. This means the NSW and ACT formula can lead to an increase in the transfer value of a vote.

To stop this happening, both jurisdiction place an upper limit on the transfer value. In NSW, random sampling means the transfer value is capped at 1, so if the surplus is greater than the continuing ballot papers, then all ballot papers are distributed.

Under the ACT system, the upper limit of the transfer value is set equal to the current transfer value. So if a ballot paper has transfer value = 0.5, the calculation of a new transfer value cannot increase the new transfer value above 0.5.

As a minimum implementation of fractional transfer value computerised counting, this change to the upper limit of a transfer value must be legislated.

Excluding exhausting preferences before calculating transfer value gives maximum weight to ballot papers with preferences beyond the elected candidate, and leaves exhausted ballot papers with the last elected candidate reached.

If Exhausting preferences are not first excluded, you have the situation where votes with further preferences effectively get left with an elected candidate, and votes with no further preferences are transferred to the total of exhausted votes.

It is my view that leaving exhausting ballot papers with the last elected candidate, and distributing votes with further preferences, is the preferred transfer value formula. I would recommend that NSW continue to use a transfer value formula that first excludes exhausting preferences.

If the expanded Gregory methods outlined below are implemented, similar capping would need to be included if exhausted preferences are dealt with in the transfer value formula.

Expansions on the Gregory Method

PR-STV as implemented in upper houses elsewhere in Australia uses an expansion on the basic Gregory method. Instead of only examining the last bundle of votes that put a candidate over the quota, all ballot papers/votes held by a candidate are examined.

There are two versions of the method, the Inclusive Gregory used for the Senate and the Legislative Councils in Victoria and South Australia, and the Weighted Inclusive Gregory Method used for the Western Australian Legislative Council.

The Transfer Value Formula for the Inclusive Gregory Method is

Transfer Value = Votes Surplus / Total **Ballot Papers** held

This transfer value is then applied to all **ballot papers** on distributing preferences.

For the Weighted Inclusive Gregory Method the formula is

Transfer Value = Vote Surplus / Total **Votes** held

This formula is then applied to all **votes** distributed as part of the surplus.

The Inclusive Gregory formula uses Ballot Papers in the divisor, a method designed to simplify processing for a manual count.

The Weighted Inclusive Gregory method is harder for manual counting but is fairer and should be used for computer counts.

To explain why this matters, let me refer to the following example.

Consider an election with a quota of 100,000. Party A has 230,000 votes (2.3 quotas) and Party B 90,000 (0.9 quotas). Party A initially elects two members and had a surplus of 30,000 votes and these all flow to Party B, putting Party B over the quota.

Under the Gregory or last bundle method, the only votes examined for preferences here would be the 30,000 received from Party A. The transfer value would be 20,000 / 30,000 = 0.666667.

More importantly, the preferences distributed would all be from Party A. There would be no Party B preferences in the surplus following the election of Party B.

The Inclusive and Weighted Inclusive Gregory methods look at all votes held by Party B at the point they pass the quota, not just the last bundle. However, Inclusive Gregory works on ballot papers and distorts the flow of preferences compared to the vote-based Weighted Inclusive Gregory method.

Party B was elected by the 30,000 preferences from Party A, putting Party B 20,000 votes over the quota, but this 30,000 votes received as preferences corresponded to 230,000 original ballot papers.

Under the Inclusive Gregory Method, the transfer value would be

TV = 20,000/(90,000 + 230,000) = 0.062500

Under the Weighted Inclusive Gregory Method it would be

TV = 20,000/(90,000 + 30,000) = 0.166666

Under the Inclusive Gregory Formula, the surplus following the exclusion of Party B would have only 5,625 next preferences originally from Party B, but 14,375 originally from Party B. The Inclusive Gregory formula based on ballot papers distorts the surplus in favour of Party A.

Using the Weighted Inclusive Gregory method, Party B's surplus would include 15,000 votes originally from Party B and only 5,000 originally from Party A, better reflecting the votes held at the point where Party B was elected.

The Weighted Inclusive Gregory method clearly gives better effect to the weight of votes that elected a candidate and created a surplus, while the Inclusive Gregory method distorts the composition of a candidate's surplus.

Bundling or Segmenting the Count

When a candidate is being excluded from the count and their preferences distributed, should all votes be distributed at once, or should the distribution be segmented or broken up into bundles?

Currently all Australian PR-STV systems segment the count on distributing the preferences of an excluded candidate.

The Senate, Tasmania and ACT exclude and distribute preferences in bundles corresponding to transfer value. All votes at full value (Transfer value = 1) are distributed first, then counts are conducted for each bundle of votes at equal transfer value, in order of descending transfer value.

Victoria has a slight variation on this model in that a candidate's first preference vote are the first bundle, the second bundle is all excluded preferences received at full value (TV=1), and then bundles are distributed in descending transfer value order.

Western Australia and South Australia use a different method, what can be termed individual bundling. When a candidate is excluded, their preferences are distributed bundle by bundle in the order that each bundle was received. There is no re-ordering of bundles based on transfer value.

Under the WA and SA rules, the first preference votes comprise the first bundle, the second bundle is the next bundle of votes received as preferences, followed by the third and so on in the order that each bundle was received.

In theory all bundles could be distributed at once. The current segmentation of an exclusion is partly to simplify manual counting.

It is also an attempt to limit the impact of distortions created by the use of an Inclusive Gregory transfer value formula. This would be less of a problem if the Weighted Inclusive Gregory transfer value formula is used.

Segmentation is important because under PR-STV rules, any candidate that receives votes as preferences and achieves a quota then receives no further preferences.

The use of individual bundling in WA and SA means that the bundles distributed at each distribution are smaller, and the size of any surplus achieved by an elected candidate will also therefore be smaller.

Larger transfer bundles means that surpluses can be larger.

The larger a surplus, the more that a candidate's first and earlier received preferences are included in a surplus. The smaller a transfer and the smaller the surplus, the more that ballot papers distributed from an excluded candidate can give full effect to their preferences without being washed through another candidate's surplus.

However, it is very difficult to define one method as more correct than another. Whichever way the count is conducted, there is always the chance that the result will be influenced by the order candidates are excluded. The count is conducted by a set of rules, but it can be difficult to be purist and define one method of bundling is more correct than another.

Examples of Where Formulas and Bundles Matter.

At the 2014 Victorian election, the identity of the last candidate elected in Northern Victoria Region was changed by the use of the Inclusive Gregory rather than the Weighted Inclusive Gregory Method.

At the 2017 Western Australian election, the use of individual bundling meant that One Nation won the last seat in Eastern Metropolitan Region. Had aggregated bundling by transfer value been used the Liberal Party would have won the last seat.

While these examples of different results are rare, it is important to consider the consequences of the rules chosen to conduct a count.