Table of Contents

List of Tables

List of Figures

Summary

This submission is addressing the Joint Standing Committee on Electoral Matters, Inquiry into the 2022 Federal Election, Terms of Reference:

> *(g) proportional representation of the states and territories in the Parliament, in the context of the democratic principle of 'one vote, one value'.*

Due to the actual implementation of Australian elections there can be corruption of the 'one vote, one value' principle. Electoral reform is required.

Victorian, Local Government General Elections provides a worst-case implementation of Australian election practices. As such the election results in Victoria highlight defects in the House of Representative electoral legislation. By design these two (2) elections at the Federal and Local level have the following common characteristics:

- It is mandatory for a voter to give an indication of a preference for all candidates (i.e. casting an optional preference vote is not permitted). If a preference indication for all candidates cannot be determined a ballot-paper is rejected as informal.
- Ballot-papers do not have an above the line voting option.
- Single member electorates exist in both systems.
- A preferential counting method.
- Voting is compulsory for the electorate.
- Candidates are randomly assigned their position on a ballot-paper.
- There is no numerical limit on the number of candidates standing for election.
- There is no mitigation of Donkey Votes i.e. a Robson Rotation is not implemented. The random assignment of ballot-paper positions or the implementation of more/smaller Wards does not eliminate the impact of Donkey Votes.
- There are no corrupt election practices e.g. ballot box stuffing, etc.

This submission will show elections sharing these characteristics may not deliver results meeting the 'one vote, one value' principle. In this case study, a Chook Raffle[1] would deliver fairer results than some Victorian, Local Government elections. The public cannot have confidence all Australian elections will deliver the expected standard of results i.e. have a 'fair result[2]' that is reasonable, right and just.

Generally the influence of Donkey Votes in Australian elections is dismissed as inconsequential. Analysis will show Donkey Vote variations can have a significant level of perverse effects on election results. Analysis of Victorian, Local Government General Elections provides a case study on how unidentified Donkey Vote variations corrupt the 'one vote, one value' principle in Australian elections and produce unexpected election results.

Based on data from Table 6 the Observed and Expected Probabilities for Victorian, Local Government General Elections (2008 – 2021) can be used to generate estimates for the election of candidates at the top of ballot-papers. With fields of five (5) or more candidates it is estimate 45% more candidates at the top of ballot-papers would be elected compared to the expected results from fair elections.

[1] Wikipedia Chook Raffle article, dated 29th September 2022:- https://en.wikipedia.org/wiki/Chook_raffle
[2] Collins English Dictionary, Example Sentences, 'Fair Result' definition:- https://www.collinsdictionary.com/dictionary/english/fair-result

With fields of 15 or more candidates it is estimated that nearly twice as many candidates at the top of ballot-papers would be elected compared to the expected results from fair elections.

Figure 1 highlights how the Observed Probability is significantly higher than the Upper Marker line (i.e. three (3) Standard Errors above the Expected Probability). Table 7 implies the result is greater than 99.999,999,992%, a chance of 1 in 12,450,197,393, or if it was to be equivalent to a daily occurrence it would happen once every 34 million years (twice since the extinction of dinosaurs).

The operation of these elections favour the candidates at the top of the ballot-paper then electors who have cast a considered preference for such a successful candidate are receiving an advantage that is unavailable to a voter who has cast a considered preference for an unsuccessful candidate placed in the 6th decile of the ballot-paper. If voters for one cohort of candidates receives an election advantage then voters for other candidates have their votes devalued. Therefore the principle of 'one vote, one value' is not met.

As always, negative outcomes that should have been addressed in legislation become perfectly obvious in hindsight. Flaws in the inforce Victorian Local Government Act 2020[3] and Local Government (Electoral) Regulations 2020[4] have been addressed by the ACT and Tasmania legislation implementing best practice election laws (Acts) and regulations (Statutory Rules). Implementation of a variant of the Robson Rotation[5,6,7] used in the Australian Capital Territory (ACT) and Tasmania would ensure Donkey Vote variants do not cause these outcomes.

Unfortunately, the Victorian Minister for Local Government at the last public review of Victoria's Local Government Act did not appear inclined to act on the presented evidence of Donkey Vote bias.

At the Federal level electoral reform is required to address the same shortcomings in election design that are highlighted by the shortcomings in the Victorian, Local Government elections. Implementation of a Robson Rotation[8] should be mandatory to deliver on the 'one vote, one value' principle. Recommendations to implement a Robson Rotation to close this defect in Federal elections have been made previously and this recommendation may be one constant of electoral and legislation reviews.

This submission may represent the first time evidence is presented to show the extent previously unidentified Donkey Vote variants can impact election results in single member elections, i.e. a format typical of the House of Representative elections. The corruption of the 'one vote, one value' principle can be identified in Table 12 beginning with a field of three (3) candidates standing for election in a single Councillor Ward.

Victorian, Local Government elections do represent a worst-case implementation as their operation effectively amplifies the likelihood of Donkey Vote variants impacting election results.

---

[3] Local Government Act 2020, Authorised Version No. 16, 2nd September 2022:- https://www.legislation.vic.gov.au/in-force/acts/local-government-act-2020/016
[4] Local Government (Electoral) Regulations 2020, Authorised Version No.4, 25th April 2021:- https://www.legislation.vic.gov.au/in-force/statutory-rules/local-government-electoral-regulations-2020/004
[5] 'Ballot papers' information sheet, 'What is "Robson rotation"?', published by the ACT Electoral Commission, page 2:- https://www.tec.tas.gov.au/Info/Robson_Rotation_Paper.pdf
[6] 'A discussion paper on Robson rotation in Tasmania' published by the Tasmanian Electoral Commission, dated April 2008, pdf file:- https://www.tec.tas.gov.au/Info/Robson_Rotation_Paper.pdf
[7] Wikipedia article:- https://en.wikipedia.org/wiki/Robson_Rotation
[8] Robson Rotation article, Wikipedia 18/09/2022:- https://en.wikipedia.org/wiki/Robson_Rotation

At the Federal level, political parties have previously rejected calls to introduce a Robson Rotation. This gives the appearance short term, party political considerations outweigh holding fair elections.

Garry Page
7th October 2022

Preface

Any hyperlink or Uniform Resource Locator (URL) referencing Internet located documents or websites were correct at the time they were embedded or initially referenced in this document. Due to changes beyond the control of the author all hyperlinks and URLs are not guaranteed to remain valid or usable.

The author is responsible for any and all calculation, statistical, interpretation and typographical errors. Data collection was a manual entry process. Appendix A should be consulted for calculation details. The author is also responsible for any errors or discrepancies created when calculation results were rounded for publication and manually copied into this document. Best efforts have been made to ensure accurate references and statistics have been provided.

Introduction

Definitions

The Wikipedia[9] free encyclopaedia, Donkey Vote[10] article provides an overview explaining the meaning and impact of a Donkey Vote. Included the following text:

> *In electoral systems which use ranked voting, a **donkey vote** is a cast ballot where the voter ranks the candidates based on the order they appear on the ballot itself. The voter that votes in this manner is referred to as a **donkey voter**.*
>
> *Typically, this involves numbering the candidates in the order they appear on the ballot paper: first preference for the first-listed candidate, second preference for the second-listed candidate, and so on. However, donkey votes can also occur in reverse, such that someone numbers the candidates from the bottom up the ballot paper. In systems where a voter is required to place a number against each candidate for the vote to be valid, the voter may give the first preference to the candidate they prefer, then run all the other numbers donkey fashion.*

These definitions of **Linear** and **Reverse Linear** variants of a **Donkey Vote** form the basis of the definitions used by various Australian authorities and other sources. Refer to references listed in Table 1, plus Table 4. Although variations in the wording of these definitions exist, they consistently describe the **Linear** Donkey Vote variant. By extension some definitions include the reverse direction of the Linear variant.

Table 1 - Donkey Vote Definitions from Various Australian Sources

Definition	**Source**
a vote where a voter appears to make no choice among the candidates, but numbers preferences for candidates in the order in which they are listed on the ballot-paper	Parliament of Australia, Glossary, Donkey Vote[11]
A ballot paper marked 1, 2, 3, 4 straight down (or up) a ballot paper.	Australian Electoral Commission, Glossary, Donkey Vote[12]
A donkey vote is a vote cast by a voter who numbers the squares down (or more rarely up) the ballot paper, without caring about the nature of the candidates on offer.	Victorian Electoral Commission, Report to Parliament on the 2018 Victorian State Election, Section 15 Statistical overview of the election, Donkey Votes[13], Page 99.
A donkey vote occurs when an elector simply numbers the ballot paper from top to bottom (or bottom to top) without regard to the logic of the preference allocation.	AustralianPolitics.com website, Donkey Votes[14]

[9] Wikipedia home page:- https://en.wikipedia.org/wiki/Main_Page
[10] Extract from Wikipedia, Donkey Vote article, dated 21st September 2022:- https://en.wikipedia.org/wiki/Donkey_vote
[11] Extract from Parliament of Australia, Glossary, Donkey Vote entry, 21st September 2022:- https://www.aph.gov.au/Help/Glossary#D
[12] Extract from Australian Electoral Commission, Glossary, Donkey Vote entry, 21st September 2020:- https://www.aec.gov.au/footer/Glossary.htm#d
[13] Extract from Victorian Electoral Commission, Report To Parliament on the 2018 Victorian State Election
[14] AustralianPolitics.com Donkey Vote article:- https://australianpolitics.com/voting/donkey-votes

These current Australian definitions do not have all voting patterns that include a Donkey Vote component. Using these limited definitions causes Donkey Vote variations to be ignored and results in an underestimation of the severity of the impact of Donkey Votes on election results.

Illustration of Donkey Vote Variants

Other than **Linear** and **Reverse Linear**, there no consistent naming conventions for Donkey Vote variations. Listed below are eight (8) Donkey Vote variants:

1. **Linear** - a voter appears to make no choice among the candidates, but numbers preferences for candidates in the **order** in which they are listed down the ballot-paper. The 'classic' definition of a Donkey Vote.
2. **Reverse Linear** - a voter appears to make no choice among the candidates, but numbers preferences for candidates in the reverse order in which they are listed on the ballot-paper
3. **Circular** - a voter appears to cast a **considered first preference** among the candidates, then appears to make no further choice among the remaining candidates i.e. starting at the next candidate immediately below the considered first preference they number preferences for the other candidates in the **order** in which they are listed on the ballot-paper.
4. **Reverse Circular** - a voter appears to cast a **considered first preference** among the candidates, then appears to make no choice among the remaining candidates i.e. starting at the next candidate immediately above the considered first preference they number preferences for the other candidates in the **reverse order** in which they are listed on the ballot-paper.
5. **Partial Linear** - a voter appears to cast **considered votes** for a number of candidates, then appears to make no choice among the remaining candidates i.e. numbers preferences for the other candidates in the **order** in which they are listed on the ballot-paper.
6. **Reverse Partial Linear** - a voter appears to cast **considered votes** for a number of candidates, then appears to make no choice among the remaining candidates i.e. numbers preferences for the other candidates in the **reverse order** in which they are listed on the ballot-paper.
7. **Partial Circular** - a voter appears to cast **considered votes** for a number of candidates, then appears to make no choice among the remaining candidates i.e. starting at the next candidate below the last considered preference then numbers preferences for the other candidates in the **order** in which they are listed on the ballot-paper.
8. **Reverse Partial Circular** - a voter appears to cast **considered votes** for a number of candidates, then appears to make no choice among the remaining candidates i.e. starting at the next candidate above the last considered preference then numbers preferences for the other candidates in the **reverse order** in which they are listed on the ballot-paper.

To illustrate these Donkey Vote variants, Table 2 has been constructed with:

- **Linear** and **Reverse Linear** – No considered votes by the elector.
- **Circular** and **Reverse Circular** – One (1) considered vote.
- Four (4) **Partial** variants – Using more than one (1) considered vote with the **Linear** and **Circular** Donkey Vote variants yields the **Partial** Donkey Vote variants. For demonstration purposes three (3), consistent, considered votes will be highlighted. A Donkey Vote pattern will then be used to complete all ballot-papers.

Examples with zero (0), one (1) and three (3) considered votes are presented. Considered votes are highlighted in Table 2.

Table 2- Illustration of Donkey Vote Variants

Ballot Position	Linear	Reverse Linear	Circular	Reverse Circular	Partial Linear	Partial Reverse Linear	Partial Circular	Partial Reverse Circular
#1	1	10	4	8	4	10	8	6
#2	2	9	5	7	2	2	2	2
#3	3	8	6	6	5	9	9	5
#4	4	7	7	5	6	8	10	4
#5	5	6	8	4	3	3	3	3
#6	6	5	9	3	7	7	4	10
#7	7	4	10	2	8	6	5	9
#8	8	3	1	1	1	1	1	1
#9	9	2	2	10	9	5	6	8
#10	10	1	3	9	10	4	7	7

When assessing the impact of a Donkey Vote on election results only Linear and Reverse linear Donkey Votes are defined by the Parliament of Australia, the AEC and the VEC. Therefore, when Donkey Votes are included in Reports to Parliament by the Electoral Commissions (AEC and VEC) typically only the Linear and Reverse Linear variations are considered.

In some circumstances a voter may reject one or more candidates and modify their voting pattern to penalise those candidates. In Table 3 this is illustrated by adjusting the Table 2 voting patterns and allocating the last preferences to Candidates #3 and #4. This rejection of candidates is shown by striking through those preferences. Again, examples with zero (0), one (1) and three (3) considered votes are given. The same considered votes highlighted in Table 2 are shown in Table 3. The more complex Donkey Vote variants such as the **Partial Circular** variants begin to take on the appearance of a random or considered distribution of preferences.

Table 3- Illustration of Donkey Vote Variants with Rejected Candidates

Ballot Position	Linear	Reverse Linear	Circular	Reverse Circular	Partial Linear	Partial Reverse Linear	Partial Circular	Partial Reverse Circular
#1	1	8	4	6	4	8	8	4
#2	2	7	5	5	2	2	2	2
#3	~~10~~	~~10~~	~~10~~	~~10~~	~~10~~	~~10~~	~~10~~	~~10~~
#4	~~9~~	~~9~~	~~9~~	~~9~~	~~9~~	~~9~~	~~9~~	~~9~~
#5	3	6	6	4	3	3	3	3
#6	4	5	7	3	5	7	4	8
#7	5	4	8	2	6	6	5	7
#8	6	3	1	1	1	1	1	1
#9	7	2	2	8	7	5	6	6
#10	18	1	3	7	8	4	7	5

A human scanning ballot-papers to identify Donkey Votes may recognise the first 4 patterns as Donkey Vote variants (i.e. **Linear** through to **Reverse Circular**). The Partial Donkey Vote variants would be much more difficult for a human to identify and may be rejected from a Donkey Vote Variant survey of ballot-papers. If the current definitions used by Australian Parliaments and Electoral Commissions listed in Table 1 were applied all of these Donkey Vote variants would be rejected. When conducting a survey of ballot-papers pattern the recognition by computer program may be required as the appropriate method to successfully analyse, identify and categorise Donkey Vote variants.

Previous Estimations of the Impact of Donkey Votes

Detailed analysis of the election results of Australian, Local Government elections is virtually non-existent with most commentary limited to State and Federal elections

Australian State and Federal Elections

The Wikipedia article included a comment on the Australian House of Representatives and stated:

> *The donkey vote has been estimated at between 1 and 2% of the vote, which could be critical in a marginal seat[15].*

Over the years there have been a number of reports and scholarly articles attempting to estimate or discuss the impact of a donkey vote in Australia elections. A selection of these articles and reports are provided in Table 4.

Table 4 - Estimation of Donkey Votes in Australian Elections

Estimate	Election	Author	Title	Source
2% to 4%	Representatives	Malcolm Mackerras	"The Donkey Vote" for the House of Representatives	Australian Political Studies Association, Monograph No. 6 (1963), Department of Government, University of Sydney
	Representatives	C.J. Masterman	A Note on the Effect of the Donkey Vote on the House of Representatives	Australian Journal of Politics and History, Volume 10, Issue 2, 1964
1% to 2% and 3%	Senate and Representatives	Malcolm Mackerras	The "Donkey Vote"[16]	The Australian Quarterly, Volume 40, No. 4, December 1968, pp. 89-92
	Representatives	Colin A. Hughes	Alphabetic Advantage in the House of Representatives[17]	The Australian Quarterly, Volume 42, No. 3, September 1970, pp 24-29
		Malcolm Mackerras	Preference Voting and the "Donkey Vote"[18]	Politics, Volume 5, Issue 1, 1970, pp. 69-76
		Keith M. Benn	II: Donkey Vote Devaluation and the D.L.P.[19]	Politics, Volume 5, Issue 2, 1970, pp. 232-234
1.3%	Representatives	Jonathan Kelley Ian McAllister	Ballot Paper Cues and the in Australia and Britain: Alphabetic Voting, Sex and Title[20]	The Public Opinion Quarterly, Volume 48, Summer 1984, pp. 452-466
~0.65%	Representatives	David Peetz	Donkeys, deserters, and targets: causes of swing in the 1987 federal election[21]	The Australian Quarterly, Volume 61, No. 4, Summer, 1989, pp. 468-480

[15] Malcolm Mackerras, The "Donkey Vote". The Australian Quarterly, Vol 40. No. 4 (Dec., 1968), pp. 89-92
[16] Article download via the jstor.org website:- https://www.jstor.org/stable/20634244
[17] Article download via the jstor.org website:- https://www.jstor.org/stable/20634378
[18] Article download via the Taylor & Francis Group website:- https://www.tandfonline.com/doi/abs/10.1080/00323267008401194?journalCode=cajp19
[19] Article download via the Taylor & Francis Group website:- https://www.tandfonline.com/doi/abs/10.1080/00323267008401220
[20] Article download via the jstor.org website:- https://www.jstor.org/stable/2749036
[21] Article download via the jstor.org website:- https://www.jstor.org/stable/20635560

Estimate	Election	Author	Title	Source
		Graeme Orr	Ballot Order: Donkey Voting in Australia[22]	Election Law Journal, Volume 1, Number 4, 2002
1%	Representatives	Amy King Andrew Leigh	Are Ballet Order Effects Heterogeneous?[23]	Social Science Quarterly, Volume 90, Issue 1 March 2009, pp. 71-87
0.07% to 2.59%	State Election	Victorian Electoral Commission	Donkey Votes	2010 Victorian State Parliament Election Report[24], Section 11 Statistical Overview Of The Election, page 73.
0.34% to 7.53%	Senate and Representatives	Smith Kildea Gauja Keenan	The Challenge of Informed Voting in the 21st Century[25]	Electoral Regulation Research Network, Report April 2015
0.68%	State Election	Victorian Electoral Commission	Donkey Votes	2018 Victorian State Parliament Election Report[26], Section 15 Statistical Overview Of The Election, page 99.
	State Election	Antony Green	Donkey Vote Advantages for the 2021 Western Australian Election[27]	Antony Green's Election Blog, February 2021
	State Election	Antony Green	SA Election Preference Recommendations[28]	Antony Green's Election Blog, March 2022

In relation to the Donkey Vote, the VEC included in the **2010 Victorian State Parliament Election Report**[29]**, Section 11 Statistical Overview Of The Election**, Page 73, **Donkey Votes** entry:

> *A donkey vote is a vote cast by a voter who numbers the squares down the ballot paper, without caring about the nature of the candidates on offer. Candidates are pleased if they get the top spot on the ballot paper when the draw for position takes place, because they will have the advantage of the donkey vote. The size of the donkey vote has been a matter for discussion.*
>
> *The VEC counted the donkey votes as part of its survey of ballot papers. To measure real donkey votes, it is necessary to distinguish them from votes following party advice and from votes that were logically in this order given the nature of the candidates. ...*

[22] Graeme Orr paper, Pdf file download from Researchgate:- https://www.researchgate.net/publication/29458168_Ballot_Order_Donkey_Voting_in_Australia
[23] pdf file download from author's website:- http://andrewleigh.org/pdf/BallotOrder.pdf
[24] pdf file download from VEC website:- https://www.vec.vic.gov.au/-/media/08680c0035b34af4b6ea2074edc763a4.ashx
[25] pdf file download from the University of Melbourne website:- https://law.unimelb.edu.au/__data/assets/pdf_file/0009/1555956/TheChallengeofInformedVotingFinalReport2.pdf
[26] pdf file download from the VEC website:- https://www.vec.vic.gov.au/-/media/4b68a71612424c22a28e48a0d9f3d835.ashx?la=en
[27] Author's website:- https://antonygreen.com.au/donkey-vote-advantages-for-the-2021-western-australian-election/
[28] Author's website:- https://antonygreen.com.au/sa-election-preference-recommendations/
[29] Report to Parliament on the 2010 Victorian State Election:- https://www.vec.vic.gov.au/-/media/08680c0035b34af4b6ea2074edc763a4.ashx

> *Figure 64: Proportion of donkey votes minus proportion attributable to random variation on Page 73 demonstrated how minuscule impact of the Donkey Vote had on the election. In Figure 64, the proportion attributable to random variation has been subtracted. …*
>
> *In the Districts surveyed, the median donkey vote was 1% of the total formal vote. The donkey vote varied widely, from 0.07% in Rodney to 2.59% in Shepparton.*

In relation to Donkey Votes in the 2018 Victorian State Parliament Election Report, Section 15 Statistical Overview Of The Election, page 99, Donkey Votes entry:

> *In Melbourne District, there were 253 donkey votes and 22 reverse donkey votes. Donkey votes comprised only 0.68% of total formal votes for Melbourne, and 1.6% of the votes for the Greens. These figures are consistent with the VEC's 2010 survey of donkey votes in eight districts.*

All the above research highlights the minimal impact Donkey Votes have on State and Commonwealth elections. This would be due to the influence of political parties on electors, plus group voting, How-To-Vote cards, voter education, above the line voting available for Senate elections where routinely there are a large number of candidates, etc.

Australian Territory Elections

The Australian Capital Territory[30] has adopted a Robson Rotation[31] to reduce the impact of Donkey Votes. The Review of the Electoral Act 1992[32] included a 5% representative sample of ballot-papers from the 1995 and 1998 elections. Some key finding were:

- *The only obviously identifiable incidence of linear voting occurred where voters numbered the column of candidates of their first choice from the top down, with the first listed candidate receiving the first preference, the second listed candidate receiving the second preference, and so on for each candidate in the column. This kind of vote is what is meant by the use of the term "linear voting". Attempts to identify other kinds of linear voting (for example, where the candidate of first choice was not at the top of the column) did not indicate any obvious trends.*
- *Linear voting declined from 25.2% in 1995 to 22.6% in 1998. It also declined to varying degrees in each electorate.*
- *In electorate terms, the highest linear vote was 30.3% in Ginninderra in 1995, and lowest was 20.3% in Molonglo in 1998.*
- *The proportion of voters giving a first preference to the candidate at the top of the column was 41.1% in 1998 and 41.9% in 1995. Most voters gave their first preference to a candidate who was not on the top of the column on their ballot papers: 58.9% in 1998 and 58.1% in 1995.*
- *Linear votes expressed as a proportion of total first preference votes received by each candidate were generally lower for better-known major party candidates and for independent candidates.*
- *Linear votes expressed as a proportion of total first preference votes received by each candidate were generally higher for lesser-known major party candidates who received relatively fewer votes compared to better-known candidates in the same party.*

In addition to linear votes, the survey also looked at the number of sequential preferences shown by each voter:

- *In 1998, 98.0% of all formal votes complied with the ballot paper instructions to number at least as many candidates as their*(sic) *were vacancies in the electorate.*
- *Of all formal votes, 64.4% showed numbers for exactly the instructed minimum number of candidates.*
- *Around 33.6% of formal votes went further than the instructed minimum and 7.1% of formal voters numbered every candidate.*
- *Only 2.0% of formal votes failed to number at least as many candidates as there were vacancies, and only 0.6% of formal votes numbered one candidate only.*

Possible solutions to the problem

The above analysis indicates that the linear vote had the potential to influence the outcomes of both the 1995 and 1998 elections in cases where two or more candidates vying for the one seat in the same party had vote totals close to one another. In order to reduce the impact of

[30] Australian Capital Territory:- https://www.act.gov.au/
[31] Wikipedia, Robson Rotation:- https://en.wikipedia.org/wiki/Robson_Rotation
[32] Extract from The 1998 ACT Legislative Assembly Election – Review of the Electoral Act 1992, Part 1 – Significant Recommendations, Robson Rotation and the "party linear vote", The survey, pp. 4 – 5:- https://www.elections.act.gov.au/__data/assets/pdf_file/0020/831602/98electionreview.pdf

the linear vote on future elections while retaining the spirit of the Robson rotation method, the Commission considers that the best solution would be to increase the numbers of rotations of names in each column so that preferences distributed from excluded candidates are not distributed disproportionately to some candidates over others as a result of linear voting.

In 1995, the ballot papers were printed using traditional off-set printing techniques. This method did not lend itself to printing many different variations of each electorate's ballot papers. In 1998, the ballot papers were printed direct from a computer using laser printers, with "masters" for each version stored on computer disc. This method has opened up the possibility of printing many more variations of ballot papers without greatly increasing costs.
This analysis was limited to Linear Donkey Votes and did not address the impact of other Donkey Vote variations.

Australian Local Government Elections

The Tasmanian Electoral Commission[33] (TEC) investigated Donkey Votes cast in two Tasmanian local government elections. The results were published in their Robson Rotation Discussion Paper[34], dated April 2008 and included:

> ***Local government elections***
>
> *Ballot papers from the 2002 Latrobe and Meander Valley Council elections were examined. The survey of all formal ballot papers found:*
>
> - *1.4% of the ballot papers were full linear votes.*
> - *0.4% of the ballot papers were full linear votes going in the reverse direction (bottom to top).*
> - *2.4% of the ballot papers were full circular votes.*
> - *27.5% of the ballot papers showed only the minimum five preferences and 66.4% of ballot papers showed a preference for all 14 candidates. Only 6.1% voted for an in between number of candidates.*
> - *27.9% of the ballot papers contained partial linear voting. That is, voters casting their first few preferences with apparent care, and then filling in the remaining boxes in a straight sequence up or down the ballot paper.*
>
> *In summary linear voting at local government elections did not appear to be a large problem.*

TEC research confirms a small percentage of Linear and Reverse Linear votes which “did not appear to be a large problem”. Significantly, this research identified 27.9% of ballots “contained partial linear voting” a Donkey Vote variant, but failed to analyse the impact this had on election results.

As shown above, post-election analysis of Australian elections by electoral commissions typically report a very low, Linear Donkey Vote that is dismissed as not significant. In the 2020 Victorian, Local Government, General Elections the candidate at the top of the Mooreland City Council, South Ward ballot-paper did not have a 300 word candidate statement or a photograph published on the candidate information sheet.

Examination of the VEC's Distribution spreadsheet shows 269 first preference votes cast for this candidate directed their second preference to the second candidate on the Ballot Paper i.e. the beginning of a 'classic' **Linear** Donkey Vote preference sequence. There were 25,770 valid votes cast in that Ward’s election therefore these 269 represent a maximum possible 1.004% 'classic' Donkey Vote. The VEC provides a report to the State Parliament after each Local Government General Elections and using their current definition of a Donkey Vote the VEC would not consider 1% Donkey Vote worthy of comment e.g. refer to the 2020 report to parliament.

1% or 2% 'classic' (i.e. Linear) Donkey Votes could not produce the distortion shown in the election results of Victorian, Local Government, General Elections provided in Table 8. Given the distortion in the observed results for large candidate fields it is appropriate to examine the effect of alternative forms of a Donkey Vote.

Unfortunately the side effect of the restrictive VEC definition is it has unnecessarily limits its analysis to Linear Donkey Votes and excludes most forms of a Donkey Vote. The VEC does not appear to have

[33] Tasmanian Electoral Commission:- https://www.tec.tas.gov.au/
[34] Tasmanian Electoral Commission, A discussion paper on Robson rotation in Tasmania by Andrew Hawkey, dated April 2008:- https://www.tec.tas.gov.au/Info/Robson_Rotation_Paper.pdf

reported to parliament any Donkey Vote statistics for Local Government elections in the 2008 - 2020 period.

Although the Electoral Commissions typically dismiss the advantages gained by the Linear Donkey Vote and variants, the candidates recognise the advantage gained by being randomly assigned to the top of the ballot-paper. Given the advantage conferred by the Donkey Vote it is not surprising that the VEC stated:

> *Candidates are pleased if they get the top spot on the ballot paper.*

Candidates benefiting from an advantage are the ones least likely to be unhappy and lodge a protest for a review. As will be shown the current ballot-paper design does provide a significant advantage to the first listed candidate plus other candidates in the upper Deciles of a ballot-paper.

Format of Victorian Local Government General Elections

Local Government in Australia is effectively a third layer under the National and State government constitutions. Each State regulates its own form of Local Government under their individual Acts and Regulations. In Victoria the relevant legislation is the Local Government Act 2022 plus associated Statutory Rules (Regulations) such as the Local Government Electoral Regulations 2020, etc.

Every four (4) years General Elections are held for all Victorian Local Government Councils. All positions are declared vacant and a General Election is held simultaneously for every Council, Shire, Rural City and Borough in Victoria

Exceptions exist, for example the Local Government (Casey City Council) Act 2020[35] dismissed all Councillors, appointed Administrators and rescheduled the next General Elections for the City of Casey to 2024. In 2017 General Elections were held for the City of Geelong council after the City of Greater Geelong had been placed into administration in mid-2015. In 2021 General Elections were held for the South Gippsland Shire Council.

The largest Wards in 2020 had more than 35,000 electors thus providing a large pool of potential candidates. There is no upper limit on the number of Candidates that can stand for an election. In the 2008 – 2021 period the size of candidate fields standing for election in wards has varied from 1 up to 41 candidates. There are no optional preferences, typically no grouping of candidates with an above the line voting option, nor any attempt to minimize Donkey Vote impacts with a Robson Rotation.

The Local Government (Electoral) Regulations, Part 5 Voting in elections, Division 1 – Ballot Papers, Section 48 Order of candidate on ballot paper, Page 37 extract:

> 1. *The election manager must as soon as practicable after 12 noon on nomination day hold a ballot by lot whether manually or by electronic means to determine the order in which the name of each candidate is to appear on the ballot-paper.*

Typically a computer generated random draw would be performed to create the ballot-paper order with a manual draw reserved for equipment failures, etc.

Currently the majority of General Elections are held by Postal Vote. For example, the Minister for Local Government directed[36] that all 2020 General Elections were to be Postal Votes. The VEC Report to Parliament[37] stated for the 2016 General Elections that seventy-two (72) Councils held their General Elections using Postal Votes while six (6) Councils required attendance at polling booths.

For Postal Voting each candidate can submit a 300 word statement (up from 250 words in 2016) plus a photograph for inclusion in the election package sent to every elector by the VEC. A Candidate Statement cannot refer to another candidate without their written permission. As candidates are competing for a limited number of vacancies this provision is relatively rarely employed. The VEC has not published the relevant data therefore the actual use of this provision is unknown. A submitted Candidate Statement is formatted without paragraph breaks.

A number of elections in this period used attendance voting. How-to-Vote cards could be distributed at polling places. In addition, the How-to-Vote information would be required before analysis could

---

[35] Act to dismiss the City of Casey Council:- https://www.legislation.vic.gov.au/in-force/acts/local-government-casey-city-council-act-2020/002

[36] Special Victorian Government Gazette 242, 18th May 2020:- http://www.gazette.vic.gov.au/gazette/Gazettes2020/GG2020S242.pdf

[37] VEC, 2016 Local Government Elections Report, Foreword, Page iii, Footnote 1:- https://www.vec.vic.gov.au/about-us/publications/local-council-election-reports-and-plans

be attempted. The Local Government Electoral Review Discussion Paper dated September 2013, Candidate Information chapter, Current Arrangements section stated 506 How-To-Vote cards were registered for 271 candidates. The Star Community Newspaper - Dandenong, Preference Shock For Greater Dandenong Councillor article dated 12/10/2012, stated:

> *Councillors Kelly and Herring have kept their preferences open, registering five versions of their how-to-vote cards.*

Unfortunately there can be unused, alternative How-To-Vote cards registered or a candidate could even distribute multiple How-To-Vote cards, etc. Candidates without a significant number of supporters may be unable to cover all polling places for all hours therefore the percentage of voters who received appropriate How-To-Vote cards is unknown. Therefore a simple inspection of the registered How-To-Vote card records cannot determine what has been distributed.

The largest field of candidates in the 2008 - 2021 period was 41. Worst case for a voter reading a ballot information pack could be 12,300 words (41 x 300 words), a word length for a Novella. Voters in Victorian Local Government elections are required to preference every entry on the ballot paper. A voter in the largest metropolitan Wards, Rural Cities, etc., is unlikely to personally know every candidate and in the worst case they may only have the information pack to determine their preference order. Typically they will have an informed opinion on a subset of candidates that will receive their highest preferences, maybe some that will be penalised and placed last on the ballot paper. As a voter may not be able to make an informed choice about all candidates on their ballot paper, it is not surprising an individual could cast preferences in one of the variations of a Donkey Vote pattern.

Voting is compulsory and an elector must provide an indication of preferences for all candidates standing for election. All incomplete ballot-papers or those where an indication of preferences for all candidates cannot be established are discarded as informal.

In the Postal Vote election packages distributed by the VEC there are no How-to-Vote cards distributed i.e. illegal under the Local Government Act 2020. The two (2) major political groupings (Labor party and Liberal-National Party coalition) typically do not formally endorse candidates in Local Government General Elections. The Victorian Greens party has formally stood a small number of candidates. Therefore electors typically never receive any party political recommendations for their preference allocation. Leafletting, corflutes[38], door knocking, newspaper advertising, social media, etc., have been used to garner support for individual candidates.

A Preferential count is used for Wards with a single vacancy while a Proportional count is used for undivided Councils and Wards with multiple vacancies to be filled. The VEC's Counting the votes[39] web page provides an overview of these counting methods.

The 2008, 2012, 2016, 2017, 2020 and 2021 Victorian, Local Government, General Election results are available online via the VEC's Council election results[40] and other web pages. Where appropriate, the VEC publishes spreadsheets detailing the distribution of preferences. The initial subset of election results for analysis in the 2008 – 2021 period contains the results of 1,128 elections to fill 2,499 vacant

---

[38] Election placards are commonly called corflutes, but this is a proprietary brand name owned by Corex — thus the title case "c" in Corflute.
[39] Preferential and Proportional counts, VEC voter education:- https://www.vec.vic.gov.au/voting/how-voting-works/counting-votes
[40] VEC, Council election results:- https://www.vec.vic.gov.au/results/council-election-results

positions by 8,113 candidates. The VEC does not release the databases containing the records of every vote cast in every election.

The VEC has not identified an observed Donkey Vote bias or distortion of election results in their reports to the Victorian Parliament nor in their published research papers. There have not been any peer reviewed or other scholarly works published that can be used as a reference. The Labor Minister for Local Government did hold a public review of the Local Government Act prior to 2020 Local Government, General Elections. This same Donkey Vote analysis (based on earlier election data) was presented and the recommendation to introduce a Robson Rotation was ignored.

The current in force Victorian Local Government Act and Regulations do not directly mitigate the impact of Donkey Vote variations. In recent years Victoria changes to legislation has driven a move to a greater number of smaller wards. By this increased division of council areas the average number of electors per Ward is decreased and this tends to lower the number of candidates standing per ward. As the population of a Council increases this reduction in candidate fields will tend to wane. The Donkey Vote election result bias has not been eliminated by this process of dividing Councils into single Councillor Wards. It will be shown candidate fields of more than four (4) or five (5) candidates are significantly impacted by Donkey Vote variants and this division of Councils fails to address the problems inherent in electoral legislation.

A solution to the problem has been implemented in the ACT and Tasmania with the introduction of different variations of Robson Rotations. This randomizes the position of candidates on ballot papers and eliminates any top of the ballot paper advantage.

Data Validation

For the purposes of analysis here, only elections (i.e. General Elections) that elected a whole Council are included. In this analysis any single ward Council elections (i.e. by-elections) have been excluded. By-elections are typically held in isolation and may not be representative of a General Election for all the Councillors. This ensures these elections will not introduce any distortion or outliers due to variations in the composition of the field of Candidates, local issues, etc.

All election results for Melbourne City Council are excluded. Under the City of Melbourne Act 2001[41], City of Melbourne (Electoral) Regulations 2022[42] the Melbourne City Council General Elections have group tickets, direct election of the Mayor with Deputy Mayor, and other election practices such as optional preferential voting that are not applicable to any other Victorian council.

Countbacks can use the election results from a General Election to fill casual vacancies that occur during the four (4) year term of a Council. These do not trigger a new By-election or generate a fresh set of election results. Therefore the original election results include any Countbacks.

Analysis does not include Wards where the number of candidates was less than or equal to the number of vacancies. In these cases the candidates are automatically appointed without the requirement of a poll. Obviously failed elections where there are no candidates nominated for election do not appear in the analysis.

Results reported in this submission have been rounded and this should cause an insignificant loss of precision for results.

After validation a Microsoft Excel spreadsheet[43] contained the results for 983 elections with 7,935 Candidates standing for 2,318 vacancies.

[41] City of Melbourne Act 2001, Authorised version 34, 6th April 2020:- https://www.legislation.vic.gov.au/in-force/acts/city-melbourne-act-2001/034
[42] City of Melbourne (Electoral) Regulations 2022, Authorised Version No. 1, 7th May 2022:- https://www.legislation.vic.gov.au/in-force/statutory-rules/city-melbourne-electoral-regulations-2022/001
[43] All data could be made available.

Methods to Identify Donkey Vote Bias

A Candidate is either elected or fails to be elected. When election results are coded for entry into a spreadsheet or database it is appropriate to use the value of one (1) for a successful candidate and if the Candidate fails to be elected the entry is zero (0

In the absence of formal, major political party affiliations it is assumed that the election in each Ward is independent of the others; this will not always be the case, but is a useful starting point. It is assumed that Wards of comparable faced with the same number of candidates may be regarded as "identical" trials. To the extent to which these assumptions apply the elections as a whole may be approximately regarded as a set of Bernoulli Trials[44]. For the purpose Therefore the coding of zero (0) nd one (1) (i.e. only two (2) possible outcomes) for this analysis is appropriate. A Candidate can only stand for election in one Ward. The major political parties (e.g. Liberal, Labor) do not direct preferences. Each election is run as an individual race s are also independent. Therefore results from individual General Elections can be interpreted as The appropriate methodology for analysis of election results is based upon the Bernoulli Distribution[45]. Calculations in this submission will include Variance[46], Standard Error[47], etc. Refer to Appendix A for details.

Analysis is provided for the election results from a number of Victorian, Local Government General Elections (2008, 2012, 2016, 2017, 2020 and 2021). Examination of Donkey Vote bias is performed using two (2) different methodologies:

1. Probability of election of the Candidate at the top of Ballot Papers i.e. Candidate#1.
2. Probability of election of Candidates by Deciles[48]

Both show the bias from Donkey Votes impacting Victorian, Local Government elections has been seriously underestimated. An overview of a Microsoft Excel spreadsheet design, formulae, etc., is provided in Appendix A.

[44] Wikipedia article:- https://en.wikipedia.org/wiki/Bernoulli_trial
[45] Wikipedia article:- https://en.wikipedia.org/wiki/Bernoulli_distribution
[46] Wikipedia article:- https://en.wikipedia.org/wiki/Bernoulli_distribution#Variance
[47] Wikipedia Article:- https://en.wikipedia.org/wiki/Standard_error
[48] Wikipedia definition:- https://en.wikipedia.org/wiki/Decile

Identification of Donkey Vote Bias By Observed Probability

Assignment of Ballot-Paper Positions

Some candidates will receive a disproportionately higher number of votes than others due to their popularity with electors. A small number of candidates will receive enough first preference votes to be elected without the distribution of preferences. If a disproportionately high number of candidates at the top of ballot-papers are being elected it could be that a disproportionately high number of high popularity candidates are being assigned to the top of ballot-papers.

Electoral commissions create ballot-papers by randomly assigning candidates to their positions on a ballot-paper. As candidates are randomly assigned to their ballot positions the popular candidates can be assigned to any position on a ballot paper. When a data set includes a sufficient number of elections the high popularity candidates will be tend to be evenly distributed across all positions on ballot-papers. Therefore if a disproportionately high number of candidates at the top of the ballot-papers are elected it is unlikely a disproportionate number of high popularity candidates are being assigned to the top of the ballot-papers.

Given the published data, an Observed Probability of election of candidates assigned to any position on a ballot paper can be calculated. This Observed Probability can be simply calculated by counting the number of candidates elected at a particular position on ballot papers against the number elections in the sample. By counting the number of successful candidates elected in a statistically significant number of elections it is possible to determine a useful Observed Probability [p]. Against the Observed Probability can be compared the Expected Probability of election as if it were true that ballot-paper position does not matter.

Constructing a Candidate<field size> for Analysis

Initially election results were going to be analysed by the number of candidates standing for election in a Ward. Although there are hundreds of election results, only for elections with the smallest Candidate fields are there a sufficient number available for meaningful analysis.

In the case of single member (Councillor) elections, Table 5 shows the candidate field sizes for the General Elections in the 2008 to 2021 period varies from 2 to 18 candidates. In the case of single member elections there are an insufficient number of elections for analysis to provide reliable results when the candidate field size is greater than or equal to seven (7). Analysis for candidate field sizes of seven (7) or more can only provide indicative results.

Table 5 - Candidate Fields in Single Vacancy Wards

Vacancies	Candidates	Election Count
1	2	104
1	3	104
1	4	66
1	5	53
1	6	39
1	7	22
1	8	18
1	9	10
1	10	10
1	11	3
1	12	6
1	13	1
1	14	2
1	15	0
1	16	1
1	17	0
1	18	1

Constructing Candidate Ranges<field size to field size> for Analysis

To overcome the problem of a limited number of election results per **Candidate<field size>**, this analysis utilizes weighted averages based upon Candidate field size number ranges. In the period under consideration the largest field was 41 Candidates standing in one Ward. Therefore Candidate Ranges in tables are in the form of **Candidate<field size – 41>** i.e. all ranges include the highest candidate number (**Candidate**<**41**>) to enable an estimation of how the donkey vote bias has impacted on the election results.

If the **Candidate Ranges** started from the lowest candidate field size (e.g. **Candidate Range**<**2 – field size**>) then the very large number of results for Wards with less than or equal to 7 candidates would swamp the results from the less numerous, higher Candidate field size wards. This would mask the impact of the Donkey Vote bias. The tables do include **Candidate Range**<**2 - 41**> which does include all election results being analysed.

Expected Probability (E[p]), **Upper Marker** (E[p] +3x Standard Error) and **Lower Marker** (E[p] - 3x Standard Error) values have been calculated from the number of vacancies to be filled and the number of Candidates standing in each Ward. The Upper and Lower Markers are just to illustrate the magnitude of the difference between the Expected and Observed Probabilities. These markers will be used in the Figure 1 graph. The **Observed Probability** (p) is calculated from the Candidates that were successfully elected in each Ward.

A previously published[49] submission by this author provided analysis for the 2012 – 2017 Victorian, Local Government, General Elections. In the earlier analysis the lower bound intercept of the Y-axis was at **Candidate Range<2 – 19>**. With this analysis for 2008 – 2021 the increased number of election results has decreased the Standard Error and the Y-axis intercept has increased to **Candidate Range<2 - 21>**. The addition of future election results should continue this gradual reduction in the Standard Error.

[49] Local Government Act Review submission, 30th September 2020, Page 10-16:- https://www.parliament.vic.gov.au/images/stories/committees/emc/Social_Media_Subs_2020/87.b_Attachment_1_-_Garry_Page.pdf

Probability of Election of Candidates at the Top of Ballot Papers

Observed Probability (p) for election of the Candidate at the top of ballot-papers is calculated from the number of successful elections by the top candidate (**Candidate#1**) on the ballot-paper. Calculations did include all **Candidate<field size** - **41**> ranges but not all have been reported in this submission.

The probability of an individual candidate being elected was calculated for every election. **Expected Probability** [Ep] for the Candidate Ranges was then calculated as the average of each Candidate's Expected Probability.

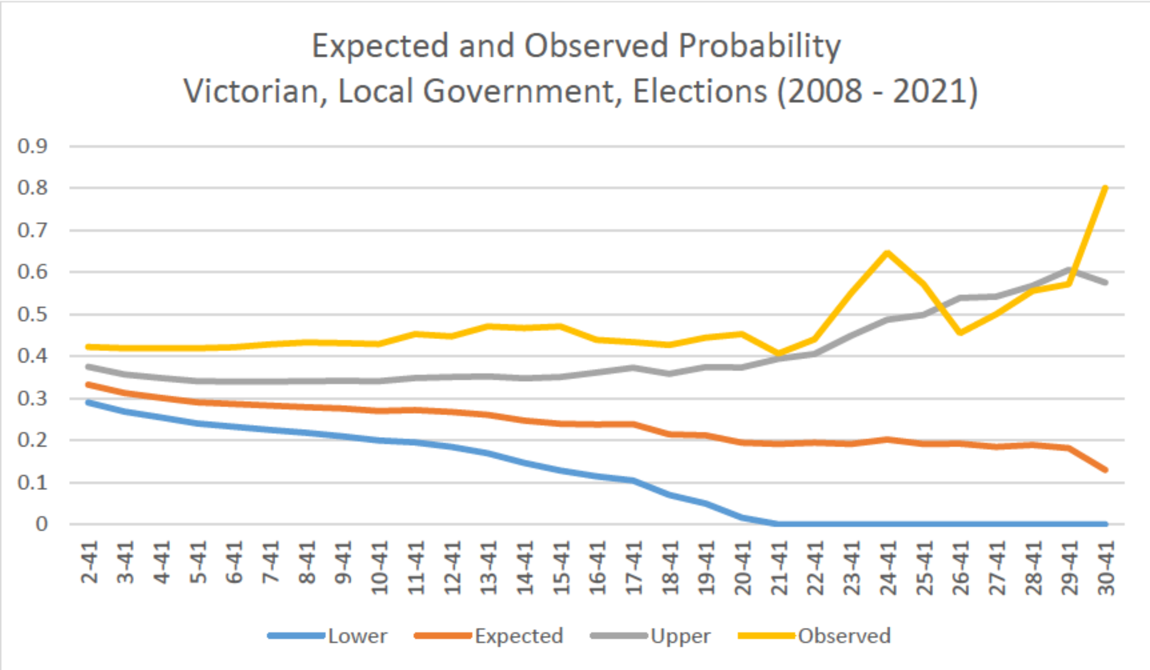

Figure 1 - Expected and Observed Probability Local Government Elections (2008 - 2021)

From **Candidate Range<2 - 41>** to **<25 – 41>** the Observed Probabilities are more than three (3) Standard Errors above the Expected Probabilities. Given these results are above three (3) Standard Errors (i.e. the upper marker) the difference has been calculated in Table 6 as **Delta Standard Errors** using the formula (Observed – Expected) / Standard Error.

As the number of election results decreases, the accuracy of the calculation results may also decrease. The **Candidate Range<21 – 41>** and higher are greyed out in Table 6 as they are only providing a likely trend line. **Candidate Range<20 – 41>** has the results for 1023 candidates standing in 42 elections and has been selected as the highest Candidate Range with reliable result calculations.

Table 6 - Expected and Observed Probability for Election of Candidate#1 (2008 – 2021)

Candidate Range	Elections	Candidates	Elected (Candidate#1)	Observed Probability [p]	Expected Probability [Ep]	Standard Error	Lower Marker	Upper Marker	Delta Standard Errors
30 - 41	5	183	4	0 8000	0 1296	0 1485	0 0000	0 5749	4 5
29 – 41	7	241	4	0 5714	0 1812	0 1414	0 0000	0 6053	2 8
28 – 41	9	297	5	0 5556	0 1886	0 1263	0 0000	0 5676	2 9
27 – 41	10	324	5	0 5000	0 1845	0 1911	0 0000	0 5419	2 6
26 – 41	11	350	5	0 4545	0 1922	0 1156	0 0000	0 5389	2 3
25 – 41	14	425	8	0 5714	0 1910	0 1025	0 0000	0 4984	3 7
24 – 41	17	497	11	0 6471	0 2014	0 0950	0 0000	0 4865	4 7
23 – 41	20	566	11	0 5500	0 1908	0 0859	0 0000	0 4484	4 2
22 – 41	25	676	11	0 4400	0 1944	0 0752	0 0000	0 4054	3 5
21 – 41	32	823	13	0 4063	0 1911	0 0676	0 0000	0 3938	3 2
20 – 41	42	1023	19	0 4524	0 1944	0 0595	0 0160	0 3729	4 3
19 – 41	54	1251	24	0 4444	0 2117	0 0540	0 0497	0 3736	4 3
18 – 41	68	1503	29	0 4265	0 2138	0 0480	0 0697	0 3579	4 4
17 – 41	83	1758	36	0 4337	0 2383	0 0446	0 1044	0 3722	4 4
16 – 41	98	1998	43	0 4388	0 2375	0 0411	0 1142	0 3608	4 9
15 - 41	121	2343	57	0 4711	0 2392	0 0371	0 1280	0 3504	6 3
14 – 41	150	2749	70	0 4667	0 2468	0 0335	0 1462	0 3473	6 6
13 – 41	187	3230	88	0 4706	0 2605	0 0304	0 1692	0 3517	6 9
12 – 41	226	3698	101	0 4469	0 2671	0 0278	0 1839	0 3504	6 5
11 – 41	272	4204	123	0 4522	0 2718	0 0255	0 1951	0 3484	7 1
10 – 41	324	4724	139	0 4290	0 2698	0 0234	0 1995	0 3401	6 8
9 – 41	369	5129	159	0 4309	0 2754	0 0220	0 2094	0 3415	7 1
8 – 41	432	5633	187	0 4329	0 2790	0 0205	0 2175	0 3404	7 5
7 – 41	495	6074	212	0 4283	0 2824	0 0192	0 2248	0 3400	7 6
6 – 41	572	6536	241	0 4213	0 2861	0 0179	0 2324	0 3397	7 6
5 – 41	657	6961	275	0 4186	0 2902	0 0167	0 2400	0 3403	7 7
4 – 41	757	7361	317	0 4188	0 3010	0 0157	0 2540	0 3480	7 5
3 – 41	879	7727	368	0 4187	0 3123	0 0147	0 2681	0 3566	7 2
2 – 41	983	7935	415	0 4222	0 3322	0 0142	0 2897	0 3747	6 4

This analysis does rely on the distribution of election results for each Candidate Range approximating a Normal Distribution. For the case of **Candidate Range<21 – 41>** the lower tail is truncated which means the distribution will begin to become skewed. As the Candidate Range increases so will the truncation of the lower tail. High skewness will lead to misleading results.

The number of available election results decreases as the Candidate Range increases which will lower the reliability of the results and increase volatility. Therefore the results for **Candidate Range<21 – 41>** and above are just indicative of a trend and more election results from future General Elections will be required for these calculations. There has not been any calculations of skewness, nor any compensation in the current calculations for skewness.

The selection of the **Candidate Range<20 – 41>** as the highest candidate range providing reliable results is in many ways arbitrarily too low and a higher candidate range could have been selected. For example, **Candidate Range<2 - 41>** through to **Candidate Range<21 - 41>** all have 32 or more election results where a total of 823 Candidates stood for election in the 32 elections for the **Candidate Range<21 - 41>**.

When the Observed Probability is above the Upper marker line of three (3) Standard Errors it can be difficult to appreciate its significance. Just for illustration purposes the following [Normal distribution approximations](https://en.wikipedia.org/wiki/68%E2%80%9395%E2%80%9399.7_rule)[50] are provided. The column for daily events is based on an event that occurs once per day (1 in 1). If the event frequency was one (1) event in seven (7) then it would occur once per week.

[50] Wikipedia entry:- https://en.wikipedia.org/wiki/68%E2%80%9395%E2%80%9399.7_ru10.3le

Table 7 - Normal Distribution

	Expected percentage of population inside range	Approximate expected frequency outside range	Approximate frequency for daily event
$\mu \pm 2.0\sigma$	95.4%	1 in 22	Every three (3) weeks
$\mu \pm 2.5\sigma$	98.7%	1 in 81	Quarterly
$\mu \pm 3.0\sigma$	99.7%	1 in 370	Yearly
$\mu \pm 3.5\sigma$	99.95%	1 in 2,149	Every 6 years
$\mu \pm 4.0\sigma$	99.994%	1 in 15,787	Every 43 years (twice in a lifetime)
$\mu \pm 4.5\sigma$	99.999,3%	1 in 147,160	Every 403 years (once in the modern era)
$\mu \pm 5.0\sigma$	99.999,94%	1 in 1,744,278	Every 4,776 years (once in recorded history)
$\mu \pm 5.5\sigma$	99.999,996%	1 in 26,330,254	Every 72,090 years (thrice in history of modern humankind)
$\mu \pm 6.0\sigma$	99.999,999,8%	1 in 506,797,346	Every 1.38 million years (twice in history of humankind)
$\mu \pm 6.5\sigma$	99.999,999,992%	1 in 12,450,197,393	Every 34 million years (twice since the extinction of dinosaurs
$\mu \pm 7.0\sigma$	99.9999999997%	1 in 390,682,215,445	Every 1.07 billion years (four occurrences in history of earth)

Given **Candidate Ranges<2 – 41>** through **<15 – 41>** are 6.0 Standard Errors or higher than the Expected Probability. As can be seen by Table 7 there is virtually zero (0) possibility these results occurred by chance. Given ballot-box stuffing and other corrupt practices are not a feature of Australian elections then Donkey Vote variations are the only reasonable explanation for the **Observed Probability** for Candidate#1.

An alternative presentation is to calculate the result for 100 elections using the Observed and Expected Probabilities. With field sizes of 15 or more candidates nearly twice as many candidates at the top of ballot-papers are elected.

The results for the **Candidate Range<25 – 41>** are only included in Table 8 to show the trend line for the Observed Probability is likely to continue above the Expected Probability. Therefore the **Candidate Range<25 – 41>** in Table 8 is greyed out to highlight its status.

Table 8 - Estimation of Donkey Vote Bias

Candidate Range	Ep	p	100 x Ep	100 x p	Additional Candidates #1
<25 – 41>	0.1910	0.5714	19	57	38
<20 – 41>	0.1944	0.4524	19	45	26
<15 – 41>	0.2392	0.4711	24	47	23
<10 – 41>	0.2698	0.4290	27	43	16
<5 – 41>	0.2902	0.4186	29	42	13
<2 – 41>	0.3322	0.4222	33	42	9

Standard Deviation Calculations Not To Be Used

A simple error is to assume the Microsoft Excel's Standard Deviation functions are appropriate for the analysis of this discrete data. As an example when evaluating the Expected Probability that Candidate#1 is elected (**E[Pr{C1 wins}]**) for **Candidate Range<2 – 41>** it may be mistakenly assumed these Excel functions are appropriate:

- **STDEV.P** is the Standard Deviation based on an entire population. In this case it is mistakenly assumed calculating **STDEV.P** for all election results published for the period 2008 – 2021 on the VEC website forms a total population. For **Candidate Range<2 – 41>** then **STDEV.P** is 0.15704

- **STDEV.S** is the Standard Deviation based on a sample. In this case it is mistakenly assumed calculating **STDEV.S** for the election results published for the period 2008 – 2021 is a subset of the available election results from the VEC[51]. For **Candidate Range<2 – 41>** then **STDEV.S** is 0.15712

Given 983 election results there is virtually no difference between the **STDEV.P** and **STDEV.S** values. When calculating the number of Standard Deviations the Observed Probability is above the Expected Probability a formula may be contemplated such as:

(Observed – Expected) / Standard Deviation

As an example, if calculating the difference in Standard Deviations using the **STDEV.S** function the result would be 0.57267 i.e. less than one (1) Standard Deviation.

On the basis of this calculations then it would be mistakenly assumed Donkey Votes cannot have a significant impact on election results. The catch is that Standard Deviation calculations are not appropriate for this discrete, weighted average data and Standard Error delivers a significantly different result of a 6.4 Standard Error difference. It is virtually certain that Donkey Votes have a significant impact on election results which is the opposite conclusion to be drawn from these calculations.

[51] VEC website, Results, Council election results webpage states "If you require data for elections prior to 2008, please contact us."

Analysis By Deciles

On the basis that the Observed Probability does indicate the election of additional candidates above the Expected Probability for Candidate#1, then it needs to be shown which Candidates are being disadvantaged. The Candidate Range<21 – 41> and higher are greyed out in Table 9 as they are only providing a likely trend line.

Table 9 - Results by Deciles for Victorian Local Government General Elections (2008 – 2021)

Candidate Range	Vacancies	Candidates	Decile #1	Decile #2	Decile #3	Decile #4	Decile #5	Decile #6	Decile #7	Decile #8	Decile #9	Decile #10
30 – 41	24	183	5.0	5.6	1.7	2.7	1.0	0.8	1.2	1.0	3.0	2.0
29 – 41	42	241	7.9	8.5	1.9	4.3	2.9	2.7	2.1	2.7	4.1	4.9
28 – 41	54	269	9.9	9.1	3.3	5.5	4.7	2.7	3.7	4.1	5.1	5.9
27 – 41	58	324	9.9	9.1	4.3	5.5	4.7	2.9	5.5	4.1	6.1	5.9
26 – 41	65	350	10.9	9.1	5.1	5.7	4.7	3.5	6.9	5.9	6.7	6.5
25 – 41	79	425	13.9	10.1	5.1	6.7	5.7	4.5	7.9	8.9	7.7	8.5
24 – 41	97	497	17.9	11.7	6.5	7.3	7.1	5.5	10.3	11.5	8.3	10.9
23 – 41	106	543	18.9	12.7	8.5	8.5	9.4	6.0	10.3	11.9	8.9	10.9
22 – 41	121	676	19.3	15.5	12.3	10.3	9.6	7.2	12.5	12.5	8.9	12.9
21 – 41	155	823	22.7	20.3	16.7	14.1	12.2	8.8	15.6	17.4	11.3	15.9
20 – 41	196	1023	31.7	23.3	20.7	19.1	14.2	10.8	18.6	20.4	14.3	22.9
19 – 41	258	1251	38.5	32.9	29.1	22.5	21.0	16.0	23.6	26.8	18.1	29.5
18 – 41	314	1503	45.1	37.1	33.5	26.9	28.4	20.4	30.0	30.4	24.3	37.9
17 – 41	403	1758	55.6	45.2	43.6	37.2	38.4	29.0	36.0	38.4	33.5	46.1
16 – 41	459	1998	64.4	55.6	50.0	40.4	45.6	32.2	41.8	40.0	38.1	50.9
15 – 41	544	2343	79.9	62.1	59.5	49.9	52.6	38.2	50.8	46.0	44.1	60.9
14 – 41	657	2749	96.1	74.1	78.1	62.5	62.2	45.2	60.0	57.4	50.7	70.7
13 – 41	809	3230	115.9	83.7	92.5	76.1	76.8	58.2	76.2	72.2	67.2	90.2
12 – 41	949	3698	131.5	100.9	111.7	87.7	92.2	68.8	88.2	87.2	78.8	102.0
11 – 41	1098	4204	155.0	119.0	133.4	99.8	106.3	81.7	100.9	99.1	89.8	113.0
10 – 41	1233	4724	171.0	132.0	151.4	112.8	121.3	94.7	113.9	109.1	102.8	124.0
9 – 41	1361	5129	189.0	144.4	163.8	126.0	131.3	103.9	127.7	125.1	112.3	137.5
8 – 41	1512	5633	211.4	164.4	177.0	134.8	144.9	118.3	142.7	138.3	125.1	155.1
7 – 41	1647	6074	228.9	180.3	191.4	147.4	157.5	130.7	154.6	152.0	137.9	166.3
6 – 41	1790	6536	246.3	196.3	204.6	153.4	174.9	145.7	168.8	164.6	148.9	176.5
5 – 41	1925	6961	263.3	213.3	217.6	176.4	190.9	161.7	178.8	174.6	160.4	188.0
4 – 41	2074	7361	280.1	230.1	233.6	191.6	206.1	176.1	193.2	188.4	173.6	201.2
3 – 41	2214	7727	295.4	245.4	248.9	206.1	220.2	190.2	206.8	201.0	186.2	213.8
2 – 41	2318	7935	304.8	254.8	258.3	215.5	229.6	201.6	218.2	212.4	197.6	225.2

In Table 9 for all Candidate Ranges except <29-41> the candidates randomly allocated by the VEC to Decile #6 have the lowest chance to be elected. In Table 10 the raw results from Table 9 are scaled by the raw results of Decile #6. The Candidate Range <21 – 41> and higher are greyed out in Table 10 as they are only providing a likely trend line.

Table 10 - Scaled Results by Deciles for Local Government General Elections (2008 – 2021)

Candidate Range	Decile #1	Decile #2	Decile #3	Decile #4	Decile #5	Decile #6	Decile #7	Decile #8	Decile #9	Decile #10
30 – 41	6.25	7.00	2.13	3.38	1.25	1.00	1.50	1.25	3.75	2.50
29 – 41	2.93	3.15	0.70	1.59	1.07	1.00	0.78	1.00	1.52	1.81
28 – 41	3.67	3.37	1.22	2.04	1.74	1.00	1.37	1.52	1.89	2.19
27 – 41	3.41	3.14	1.48	1.90	1.62	1.00	1.90	1.41	2.10	2.03
26 – 41	3.11	2.60	1.46	1.63	1.34	1.00	1.97	1.69	1.91	1.86
25 – 41	3.09	2.24	1.13	1.49	1.27	1.00	1.76	1.98	1.71	1.89
24 – 41	3.25	2.13	1.18	1.33	1.29	1.00	1.87	2.09	1.51	1.98
23 – 41	3.15	2.12	1.42	1.42	1.57	1.00	1.72	1.98	1.48	1.82
22 – 41	2.68	2.15	1.71	1.43	1.33	1.00	1.74	1.74	1.24	1.79
21 – 41	2.58	2.31	1.90	1.60	1.39	1.00	1.77	1.98	1.28	1.81
20 – 41	2.94	2.16	1.92	1.77	1.31	1.00	1.72	1.89	1.32	2.12
19 – 41	2.41	2.06	1.82	1.41	1.31	1.00	1.48	1.68	1.13	1.84
18 – 41	2.21	1.82	1.64	1.32	1.39	1.00	1.47	1.49	1.19	1.86
17 – 41	1.92	1.56	1.50	1.28	1.32	1.00	1.24	1.32	1.16	1.59
16 – 41	2.00	1.73	1.55	1.25	1.42	1.00	1.30	1.24	1.18	1.58
15 – 41	2.09	1.63	1.56	1.31	1.38	1.00	1.33	1.20	1.15	1.59
14 – 41	2.13	1.64	1.73	1.38	1.38	1.00	1.33	1.27	1.12	1.56
13 – 41	1.99	1.44	1.59	1.31	1.32	1.00	1.31	1.24	1.15	1.55
12 – 41	1.91	1.47	1.62	1.27	1.34	1.00	1.28	1.27	1.15	1.48
11 – 41	1.90	1.46	1.63	1.22	1.30	1.00	1.24	1.21	1.10	1.38
10 – 41	1.81	1.39	1.60	1.19	1.28	1.00	1.20	1.15	1.09	1.31
9 – 41	1.82	1.39	1.58	1.21	1.26	1.00	1.23	1.20	1.08	1.32
8 – 41	1.79	1.39	1.50	1.14	1.22	1.00	1.21	1.17	1.06	1.31
7 – 41	1.75	1.38	1.46	1.13	1.21	1.00	1.18	1.16	1.06	1.27
6 – 41	1.69	1.35	1.40	1.12	1.20	1.00	1.16	1.13	1.02	1.21
5 – 41	1.63	1.32	1.35	1.09	1.18	1.00	1.11	1.08	0.99	1.16
4 – 41	1.59	1.31	1.33	1.09	1.17	1.00	1.10	1.07	0.99	1.14
3 – 41	1.55	1.29	1.31	1.08	1.16	1.00	1.09	1.06	0.98	1.12
2 – 41	1.51	1.26	1.28	1.07	1.14	1.00	1.08	1.05	0.98	1.12

As an example, for elections with a field of 10 or more candidates, candidates in the 1st Decile were 1.81 times more likely to be elected than the candidates the Victorian Electoral Commission (VEC) had randomly allocated to the 6th decile on the ballot-paper. While for elections with a field of 20 or more candidates, the candidates in the first decile are 2.94 time more likely to be elected.

Corruption of the 'One Vote, One Value' Principle

Fewer electors casting their first preference vote for the candidate at the top of the ballot-paper are required to elect their preferred candidate compared to electors who prefer a candidate relegated by the VEC to the 6th Decile. When the difference between these Deciles is greater than 2:1 the 'one vote, one value' principle has been shredded. Electoral reform is urgent and long overdue. The House of Representatives has the same defect and this should be addressed.

For Postal Voting each candidate can submit a 300 word statement (up from 250 words in 2016) plus a photograph for inclusion in the election package sent to every elector but there are no How-to-Vote cards. The submitted Candidate Statement is formatted without paragraph breaks.

The largest field of candidates in the 2008 to 2021 period was 41. Worst case for a voter reading a ballot information pack could be 12,300 words (41 x 300 words), a word length for a Novella. Some leafletting, corflutes[52], door knocking, local newspaper advertising, social media, etc., can occur to garner support for individual candidates.

As a candidate in past Local Government General Elections I have never meet or talked to all other candidates standing in my Ward. Therefore a voter is unlikely to personally know every candidate in large suburban Councils. In the worst case, electors may only have the information pack to determine their preference order. Voting is compulsory and an elector must provide an indication of preferences for all candidates standing for election. Any incomplete ballot-papers or those where an indication of preferences for all candidates cannot be established are discarded as informal. Typically electors will have an informed opinion on a subset of candidates that will receive their highest preferences, maybe some candidates will be penalised and placed last on the ballot paper. A voter may be unable to make an informed choice about the remaining balance of candidates on their ballot paper. It is not surprising an individual could cast preferences in one of the variations of a Donkey Vote pattern to complete their ballot-paper.

Table 11 illustrates preference flows to a candidate that is not Candidate#1. This is not attempting to show all possible combinations, just a simple subset to show the imbalance created in the distribution of preferences by a Donkey Vote variant. Two Candidates (#3 and #6) are vying for one councillor position when preferences from **Partial Linear** donkey votes are distributed.

In this example every voter has cast their first 2 votes with care for different candidate pairs then all perform a **Partial Linear** Donkey Vote for the balance. For each voter their second preference is two candidates positions above (circular) their first preference candidate number. Shading in Table 11 highlights the final preference distribution to either Candidate#3 or #6.

[52] Election placards are commonly called corflutes, but this is a proprietary brand name owned by Corex — thus the title case "c" in Corflute.

The preference numbers that are not required have been blanked for clarity. For example the Elector#1 preferences 5, 6, 7, 8, 9, and 10 were not required therefore these are not displayed in Table 11.

Table 11 - Example Distribution of Donkey Vote Variant Preferences

Ballot Position	Elector #1	Elector #2	Elector #3	Elector #4	Elector #5	Elector #6	Elector #7	Elector #8	Elector #9	Elector #10
#1	1	3		3			3		3	3
#2	3	1		2			4		4	4
#3	4	4	1	4	2		5		5	5
#4				1						
#5					1		2			
#6						1		2		
#7							1		2	
#8								1		2
#9	2								1	
#10		2								1

Candidate#3 receives 1 primary vote (Elector #3). On distribution of preferences Candidate#3 receives seven (7) distributed preferences (Electors #1, #2, #4, #5, #7, #9 and #10). Candidate#6 receives 1 primary vote (Elector #6). On distribution of preferences Candidate#6 receives one (1) distributed preference (Elector #8). As demonstrated, in an actual election a Donkey Vote variant could bias the election of more than just the Candidate at the top of the Ballot-Paper to unfairly elect candidates.

Mitigation of Donkey Votes

In recent years changes to the Victorian, Local Government legislation and government policy has driven a move to a greater number of smaller, single Councillor, Wards. After redistributions this strategy of increased division of councils tends to reduce the average number of candidates per ward. In the period 2008 – 2021 in single Councillor Wards the number of candidates standing for election has varied from one (1) to 18. This represents a reduction in candidate field sizes and provides some mitigation to reduce the severity of the Donkey Vote distortion but this has not eliminated the bias.

By performing an analysis limited to the cases of one (1) vacancy per Ward it is possible calculate Expected and Observed Probability for this strategy of smaller, single Councillor Wards.

Table 12 - Expected and Observed Probability in Single Vacancy Wards (2008 - 2021

Vacancies	Candidates	Elections	Candidate#1 Elected	Observed Probability (p)	Expected Probability (E[p])	p/E[p]
1	2	104	47	0.4519	0.5000	0.9039
1	3	104	41	0.3942	0.3333	1.1827
1	4	66	20	0.3030	0.2500	1.2121
1	5	53	16	0.3019	0.2000	1.5094
1	6	39	10	0.2564	0.1667	1.5385

It can be observed that smaller one (1) member elections typical of House of Representative Elections do not solve the problems generated by a Donkey Vote Bias.

Electoral Reform – Robson Rotation

Donkey Votes are fact and not a folklore.

Previously the assumption was Donkey Votes only represented 1% or 2% of the votes cast and had no influence on results except for the closest of elections. As has been shown, the value of a vote cast for a candidate down the ballot-paper is less likely to elect a voter's preferred candidate than a vote cast for a candidate at the top of a ballot-paper. The 'one vote, one value' principle is violated when legislation does not eliminate Donkey Votes.

When political parties craft their above the line solutions for voters in the Senate and do not print this on their How-to-Vote sheets distributed at polling booths their supporters will fall back on Donkey Vote variants. If the above the line preferences by political parties also incorporate Donkey Vote variants the final Senator position to be elected in each state is going to be disproportionally impacted by a Donkey Vote bias.

It has also been shown that Donkey Votes can impact election results with ballot-papers as simple as the House of Representatives.

A permanent solution to the Donkey Vote problem has been implemented in the ACT and Tasmania with the introduction of different variations of Robson Rotations. This randomizes the position of candidates on ballot-papers and eliminates any top of the ballot-paper advantage. In both these jurisdictions the major political parties still exist and their supporters have proven capable of adapting to a Robson Rotation. Voters are not rioting in the streets demanding the abolition of a Robson Rotation.

As the TEC observed, ballot-papers printed using traditional off-set printing techniques did not lend itself to printing many different variations of each electorate's ballot papers. The current technology has ballot-papers printed direct from a computer using laser printers, with "masters" for each version stored on computer disc. This method has opened up the possibility of printing many more variations of ballot-papers without greatly increasing costs.

The impacts on fairness and the 'one vote, one value' principle dictates that Donkey Votes should be removed from all Australian elections. As costs and voters are not an impediment to the introduction of a Robson Rotation it appears voter expectations for fairness and the 'one vote, one value' principle are being sacrificed for party political short term gains or advantages.

Conclusions

This case study based on Victorian, Local Government General Election results has established Donkey Voting does exist in fact and is not folklore. It has shown Donkey Votes can impact elections equivalent to the House of Representatives and distort election results with as few as three (3) Candidates standing for a single member electorate. The Donkey Vote problem is more serve as the number of candidates increases. There is a defect inherent in the current implementations of Australian elections that can corrupt the value of votes. Unfortunately previous studies for the House of Representatives and the Senate have ignored Donkey Vote variants and only been concerned with counting insignificant, linear donkey votes.

Costs and voters are not an impediment for electoral reform to achieve fair elections based on the 'one vote, one value' principle. Party political considerations appear to be the major impediments to electoral reform that would eliminate the impact of Donkey Votes on election results.

Garry Page

Hampton Park 3976
7th October 2022

Appendix A – Methodology

When information was being manually captured it did include additional data for each election. Only the data required by the current analysis has been described in this Appendix. As data entry was a manual process there is a small possibility of missing or incorrect data. The author is unaware of any missing or corrupt data.

The following descriptions of Microsoft Excel worksheets are written for a person with limited experience of the product. It is acknowledge that formatting the methodology this way will tend to mask or hide the process.

The intent of this Appendix is to enable another person to recreate the worksheets and perform their own analysis.

Data Entry

Accessed the following pages:

1. VEC Home
    i. Results
        1. Council election results
            a. 2008 council election results
            b. 2012 council election results
            c. 2017 Greater Geelong City Council election results
            d. 2020 council election results
    ii. Electoral Boundaries
        1. Local Councils
            a. South Gippsland Shire Council
                i. 2021 election results

The 2021 South Gippsland Shire, General Election results are not currently available on the VEC 'Council election results' web page but can be accessed by navigating to the South Gippsland Shire Council general information page. For each council (except City of Melbourne), the election results data were manually copied from the VEC web pages into a Microsoft Excel spreadsheet.

The Australian Election Database Dataverse (Australian Data Archive)[53] currently does not contain Local Government election results.

The VEC may be able to produce a set of files on media but that option was not pursued.

The format of the VEC web pages does vary so I didn't attempt to 'scrap' the pages. There may be an option to automate data collection and eliminate the manual process that has a greater potential for error.

The 2016 council election results for the City of Casey will be used in the following example. A Microsoft Excel spreadsheet named '**Data**' was created, the file name is irrelevant:

1) Column A
    a) Year
        i) All council results are grouped by Year plus all page headers state the year of the election.
            (1) 2016
2) Column B
    a) Council
        i) All council names are listed in alphabetical order of the Council. The VEC includes some duplications. For example in 2016 the **Greater Bendigo City Council** appears in the list under **B** for **Bendigo** and **G** for **Greater Bendigo**.
            (1) Casey
3) Column C
    a) Ward
        i) Each Ward recorded on their own row. Blank cell for undifferentiated councils (i.e. those councils that are not divided into Wards) and will have no Ward name recorded.
            (1) **Balla Balla**
            Edrington
            Four Oaks

[53] Australian Election Database Dataverse home page:- https://dataverse.ada.edu.au/dataverse/australian-election-database

Mayfield
River Gum
Springfield

4) Column D
   a) **Vacancies**
      i) Number of Councillors to be elected per Ward. For example Balla Balla Ward was electing a single Councillor with a Vote Counting Method of Preferential, while Mayfield Ward was electing two (2) Councillors with a Vote Counting Method of Proportional representation. In 2016 the total number of Councillors for election per council was limited to nine (9).
         (1) **Balla Balla** = **1**
         Springfield = **2**
5) Column E
   a) **Candidates**
      i) Number of Candidates standing for election per Ward. Zero (0) was recorded if no Candidates nominated for a Ward.
         (1) **Springfield** = 15
6) Columns F – AT
   a) ElectCand1 – ElectCand41
      i) Manual entry using Elected Candidates and First preference votes lists from Council results page to record election results for each Candidate. In the period 2008 to 2020 the maximum number of Candidates standing for election in a Ward was forty one (41). ElectCand(n) is the order of Candidates on ballot-papers. For example, ElectCand1 is the Candidate on the top of a ballot-paper (i.e. Candidate#1) while ElectCand41 would be the last candidate on their ballot-paper. If a candidate was not elected their cell would be Blank. For each elected candidate the order of election was recorded e.g. 1, 2, 3, … 9
         (1) **Springfield Ward**
         1st elected on the Elected candidates list, AZIZ, Sam. Placed 3rd Candidate on First Preference votes list (ballot-paper order). Therefore the **ElectCand3** = **1**
         2nd elected on the Elected candidates list, FLANNER, Rex. Placed 1st Candidate on First Preference votes list (ballot-paper order) therefore **ElectCand1** = **2**
         All other **ElectCand(n)** cells Blank.

Data Validation

New spreadsheets named ‘**Valid**’ and ‘**Deleted**’ created. And all entries from ‘**Data**’ copied to ‘**Valid**’.

‘**Valid**’ sorted into primary ascending order of **Vacancies** then ascending **Candidates** order for data validation.

From ‘**Valid**’ cut and pasted the following to ‘**Deleted**’:

- **2 rows** where Candidates equalled zero (0). These were failed elections where no Candidates stood for election and By-elections would be required to fill the vacancies.
- **1 row** where Candidates standing for election was less than the number of Vacancies. In these circumstances the Candidate(s) are successful without an election. The remaining position(s) require a By-election to fill vacancies.
- **120 rows** where one (1) Candidate stood for the election of one (1) Councillor. These Candidates are successful without an election.
- **15 rows** where two (2) Candidates stood for the election of two (2) Councillors. These Candidates are successful without an election.
- **5 rows** where three (3) Candidates stood for the election of three (3) Councillors. These Candidates are successful without an election.
- **1 row** where five (5) Candidates stood for the election of five (5) Councillors. These Candidates are successful without an election.
- **1 row** where seven (7) Candidates stood for the election of seven (7) Councillors. The Candidates are successful without an election.

After these rows were deleted ‘**Valid**’ contained 983 election results for all Victorian, Local Government, General Elections (with the exception of the City of Melbourne) held in the period of 2008 to 2021.

‘**Valid**’ sorted into ascending **Candidates** then ascending **Vacancies** order for statistics calculations.

Candidate#1 Calculations

Results are tabulated in Table 6.

On '**Valid**' spreadsheet added:

1) Column AU
   a) **Elections**
      i) One (1) election result per row. Therefore all cells equal 1.
         (1) 1
2) Column AV
   a) **E[Pr{C1 wins}]**
      i) Expected Probability that **Candidate#1** is elected. Value equal to the number of Vacancies divided by the number of Candidates. For Springfield Ward there are two (2) Vacancies with 15 Candidates standing for election. The Cell formula for Springfield Ward on row 881 was: =$D881/$E881
         (1) 0.133333333
3) Column AW
   a) **Variance**
      i) The Bernoulli distribution is the discrete probability of a random variable. When a Candidate is elected the spreadsheet entry is one (1) but if Candidate fails the entry is zero (0). A Bernoulli distribution applies to this data. If the value of one (1) has the probability p then the probability q for the value zero (0) is q=1-p. The variance of a Bernoulli Distribution equal pq = p(1-p). Therefore the cell formula for the Springfield Ward is calculated given Column AW contains the Expected Probability in Excel as =$AW881*(1-AW881)
         (1) 0.115555556
4) Column AY
   a) (Blank)
      i) Unused column

Summary Statistics

Labels in Column AY, Statistics in Column AZ

1) Cell AZ2
   a) **Number of elections**
      i) Count of elections held. Formula determines the number of elections by counting all values in Column AU and in Excel the formula is: =COUNT(AU:AU)
         (1) 983
2) Cell AZ3
   a) **Number of C1 wins**
      i) Number of Candidate#1 elected. Formula sums the number (either 0 or 1) in Column F and in Excel the formula is: =SUM(F:F)
         (1) 415
3) Cell AZ4
   a) **Proportion of C1 Wins**
      i) Proportion is the number of Candidate#1 elected divided by the number of elections and in Excel the formula is: =AZ3/AZ2
         (1) 0.42218

4) Cell AZ5
   a) **Expected proportion of C1 wins**
      i) Average of the Expected Probability of Candidate#1 being elected and the Excel formula is: =AVERAGE(AV:AV)
         (1) 0.33220
5) Cell AZ6
   a) **Standard Error**
      i) Calculated as the square root (average of the variances in Column AX divided by the number of elections) and the formula in Excel is: =SQRT(AVERAGE(AW:AW)/AZ2)
         (1) 0.01416
6) Cell AZ7
   a) **z-score**
      i) (Observed Probability – Expected Probability)/Standard Error and the formula in Excel is: =(BA4-BA5)/BA6
         (1) 6.35301
7) Cell AZ8
   a) **Maximum standard error**
      i) =0.5/SQRT(AZ2)
         (1) 0.01595
8) Cell AZ9
   a) **Minimum z-score**
      i) =(AZ4-AZ5)/AZ8
         (1) 5.64212

Expected and Observed Probability

Results are tabulated in Table 6.

1) Column BA
    a) (Blank)
        i) Unused column
2) Column BB
    a) Cell BB1
        i) #Candidates >=
            (1) Column label. Each cell of this column contains (Cn), (Cn+1)…, to form the starting value for each candidate range. The maximum number of candidates standing for election in the 2008 – 2021 period was 41 and that forms the fixed upper limit for the candidate range. Constructs an Candidate Range<(Cn) – 41> table of results.
    b) Cells BB2 – BB41
        i) 2, 3, 4, … 41
3) Column BC
    a) Elections (n)
        i) Label for the number of elections (n) held for each possible candidate range of **<Cn – 41>** from **Candidate Range<2 – 41>,** … **Candidate Range<41 – 41>**. The Excel formula is based on =SUMIF(E:E,”>=”&BB2,AU:AU) where the function is SUMIF(range, criteria, sum_range). The range is the whole of column E which contains the number of candidates standing for election sorted into ascending order. The criteria is testing each entry in the range (i.e. column E containing number of candidates standing in each election) against the criteria of:- is the number of candidates standing for election greater than or equal to the current value of cell BB in the same row. If the number of candidates standing for election is greater than or equal to the value of cell BB in the same row then the value of the election count in the sum_range (i.e. column AU containing the number of elections) is added to the sum being accumulated. The Candidate Ranges of <5 – 41>, <15 – 41 and <20 -41> will be used as examples.
            (1) For <5-41>, BB5 =5, BC5 =657 elections held where 5 or more Candidates stood. For <15-41>, BB15 =15, BC15 =121 elections held where 15 or more Candidates stood. For <20-41>, BB20 =20, BC20 =42 elections held where 20 or more Candidates stood.
4) Column BD
    a) Elected (Candidate#1)
        i) This column will contain the number of candidates at the top of the ballot-paper (Candidate#1) that were elected for a given **Candidate Range<Cn – 41>**. The Excel formula is based on =SUMIF(E:E,”>=”&$BB2,F:F) where the range and criteria is identical to Column BC. The Sum_range is column **F** which is **ElectCand1** and contains one (1) if the candidate at the top of the ballot-paper was elected and zero (0) if they failed. The Candidate Ranges of <5-41>, <15–41 and <20-41> will be used as examples.
            (1) For <5-41>, BB5 =5, BD5 =275 Candidates on top of the ballot-paper elected. For <15-41>, BB15 =15, BD15 =57 Candidates on top of the ballot-paper elected. For <20-41>, BB20 =20, BD20 =19 Candidates on top of the ballot-paper elected.
5) Column BE
    a) Candidates
        i) This column will contain the total number of candidates that stood for election for a given Candidate Range<Cn – 41>. The Excel formula is based on =SUMIF(E:E,”>=”&$BB2,E:E) where the range and criteria is identical to Column BC. The Sum_range is column **E** which

is **Candidates** and contains the number of candidates standing for an election. The Candidate Ranges of <5-41>, <15–41 and <20-41> will be used as examples.

(1) For <5-41>, BB5 =5, BE5 =6,961 Candidates stood for election. For <15-41>, BB15 =15, BE15 =2,343 Candidates stood for election. For <20-41>, BB20 =20, BE20 =1,023 Candidates stood for election.

6) Column BF

a) Observed (p)

i) This column will contain the Observed Probability for a given Candidate Range<Cn – 41>. The Excel formula is based on =SUMIF(E:E,”>+”&$BB2,F:F)/$BC2 where the range and criteria is identical to Column BC. The Sum_range is column **F** which is **ElectCand1** and contains one (1) if the candidate at the top of the ballot-paper was elected and zero (0) if they failed. The number of candidates at the top of the ballot-paper elected divided by the number of elections held for the Candidate Range gives the Observed Probability. The calculation for the total number of candidates at the top of the ballot-paper elected is identical to the formula for column BD and a simplified, alternate Excel formula is based on =BD2/BC2. The Candidate Ranges of <5-41>, <15–41 and <20-41> will be used as examples.

(1) For <5-41>, BB5 =5, BF5 =0.4186 Observed Probability for the Range<5-41>.
For <15-41>, BB15 =15, BF15 =0.4711 Observed Probability for the Range<15-41>.
For <20-41>, BB20 =20, BF20 =0.4524 Observed Probability for the Range<20-41>.

7) Column BG

a) Expected (E[p])

i) This column will contain the Expected Probability for candidates at the top of the ballot-paper that will be elected in the Candidate Range<Cn-41>. This is the sum of the Expected Probability of election calculated for each candidate divided by the total number of elections for the candidate range. The Excel formula is based on =SUMIF(E:E,”>=”&$BB2,AV:AV)/$BC2 where the range and criteria is identical to Column BC. The Sum_range is column **AV** which is **E[Pr{C1 wins}]** that is the Expected Probability that **Candidate#1** is elected. The sum of the calculated **E[Pr{C1 wins}]** divided by number of candidates elections in the candidate range gives the Expected Probability. The Candidate Ranges of <5-41>, <15–41 and <20-41> will be used as examples.

(1) For <5-41>, BB5 =5, BG5 =0.2902 Expected Probability for the Range<5-41>.
For <15-41>, BB15 =15, BG15 =0.2392 Expected Probability for the Range<15-41>.
For <20-41>, BB20 =20, BG20 =0.1944 Expected Probability for the Range<20-41>.

8) Column BH

a) Standard Error (se[p])

i) This column contains the Standard Error for the Observed Probability of the candidates at the top of the ballot-paper (Candidate #1) being elected in the Candidate Range<Cn-41>. This is the Square Root of the sum of the variances calculated for each candidate divided by the total number of elections for the candidate range. The Excel formula is based on =SQRT(SUMIF(E:E,”>=”&$BB2,AW:AW))/$BC2 where the range and criteria is identical to Column BC. The Sum_range is column **AW** which is **Variance** that is calculated from the Expected Probability that a **Candidate#1** is elected. The Candidate Ranges of <5-41>, <15–41 and <20-41> will be used as examples.

(1) For <5-41>, BB5 =5, BH5 =0.0167 Standard Error for the Range<5-41>.
For <15-41>, BB15 =15, BH15 =0.0371 Standard Error for the Range<15-41>.
For <20-41>, BB20 =20, BH20 =0.0595 Standard Error for the Range<20-41>.

9) Column BI

   a) **Lower**

      i) For Figure 1 this column provides the values for the lower level line on the graph. Calculated as three (3) Standard Errors below the Expected Probability for the Candidate Range<Cn – 41>. The minimum valid value is zero (0) give 0.0 to 1.0 are the limits for probability calculations. The Excel formula is based on =MAX(0,$BG2-3*$BH2) as the zero (0) value provides a lower limit for this function. The Candidate Ranges of <5-41>, <15–41 and <20-41> will be used as examples.

         (1) For <5-41>, BB5 =5, BI5 =0.2400 Three (3) Standard Errors line for the Range<5-41>.
         For <15-41>, BB15 =15, BI15 =0.1280 Three (3) Std. Errors for the Range<15-41>.
         For <20-41>, BB20 =20, BI20 =0.0160 Three (3) Std. Errors for the Range<20-41>.

10) Column BJ

   a) **Upper**

      i) For Figure 1 this column provides the values for the Upper level line on the graph. Calculated as three (3) Standard Errors above the Expected Probability for the Candidate Range<Cn – 41>. The maximum valid value is one (1) given 0.0 to 1.0 are the limits for probability calculations. The Excel formula is based on =MIN(1,$BG2+3*$BH2) as the one (1) value provides an upper limit for this function. The Candidate Ranges of <5-41>, <15-41 and <20-41> will be used as examples.

         (1) For <5-41>, BB5 =5, BJ5 =0.3403 Three (3) Standard Errors line for the Range<5-41>.
         For <15-41>, BB15 =15, BJ15 =0.3504 Three (3) Std. Errors for the Range<15-41>.
         For <20-41>, BB20 =20, BJ20 =0.3729 Three (3) Std. Errors for the Range<20-41>.

11) Column BK

   a) **Delta**

      i) The number of Standard Errors that the Observed Probability is above the Expected Probability. The Excel formula is based on =($BF2 - $BG2)/$BH2 . The Candidate Ranges of <5-41>, <15-41 and <20-41> will be used as examples.

         (1) For <5-41>, BB5 =5, BK5 =7.7 Three (3) Standard Errors line for the Range<5-41>.
         For <15-41>, BB15 =15, BK15 =6.3 Three (3) Std. Errors for the Range<15-41>.
         For <20-41>, BB20 =20, BK20 =4.3 Three (3) Std. Errors for the Range<20-41>.

Decile Calculations

There is nothing new or novel in this counting procedure.

Create a spreadsheet called **Deciles** then copy over the contents of the columns **A** to **AZ** from the **Valid** spreadsheet.

The order of calculations are:

Columns CO-CX
Columns BO – BX results tabulated in Table 9
Columns CB – CK results tabulated in Table 10

1) Column BN
   Cell BN1
   a) **#Candidates >=**
      i) Column label. Each cell of this column contains (Cn), (Cn+1)…, to form the starting value for each candidate range. The maximum number of candidates standing for election in the 2008 – 2021 period was 41 and that forms the fixed upper limit for the candidate range. Constructs an Candidate Range<(Cn) – 41> table of results.
   b) Cells BN2 – BN41
      i) **2, 3, 4, … 41**
2) Cell BO1 – BX1
      i) Decile Numbers
         (1) Column labels. Each cell of this range contains (Decile#n), (Decile#n+1)…, to form the label for each Decile.
   b) Cells BB2 – BB41
      i) 1, 2, 3, … 10
3) Column BO - BX
   a) Decile Numbers
      i) Contains the Decile Labels. Cells for the sum of the individual Ward elections at decile numbers (#n) calculated for each possible candidate range of **<Cn – 41>** from **Candidate Range<2 – 41>,** … **Candidate Range<41 – 41>**. The Excel formula is based on =SUMIF(E:E,”>=”&BB2,CO:CO) where the function is SUMIF(range, criteria, sum_range). The range is the whole of column E which contains the number of candidates standing for election sorted into ascending order. The criteria is testing each entry in the range (i.e. column E containing number of candidates standing in each election) against the criteria of:- is the number of candidates standing for election greater than or equal to the current value of cell BB in the same row. If the number of candidates standing for election is greater than or equal to the value of cell BB in the same row then the sum of the Deciles in the sum_range (i.e. column CO containing the 1^{st} Decile value for elections) is added to the sum being accumulated. The Candidate Ranges of <5 – 41>, <15 – 41 and <20 -41> will be used for the 1^{st} and 6^{th} as examples.
         (1) For <5-41>, BB5 =5, BO5 =263.3 sum of the 1^{st} Decile values.
             For <15-41>, BB15 =15, BO15 =79.9 sum of the 1^{st} Decile values.
             For <20-41>, BB20 =20, BO20=31.7 sum of the 1^{st} Decile values.
         (2) For <5-41>, BB5 =5, BT5 =161.7 sum of the 1^{st} Decile values.
             For <15-41>, BB15 =15, BT15 =38.2 sum of the 1^{st} Decile values.
             For <20-41>, BB20 =20, BT20=10.8 sum of the 1^{st} Decile values.
4) Column CB - CK
   a) Ratio of Decile values
      i) Contains the Decile Labels. Divides all source cells (Columns BO - BX) by the value of Decile #6 for each possible candidate range of **<Cn – 41>** from **Candidate Range<2 – 41>,** …

Candidate Range<41 – 41>. The Candidate Ranges of <5 – 41>, <15 – 41 and <20 -41> will be used for the 1st and 6th as examples. The value of the column BN cells is just a label to describe the **Candidate Ranges<BNn – 41>**

(1) For <5-41>, BN5 =5, CB5 =1.63 sum of the 1st Decile values.
For <15-41>, BN15 =15, CB15 =2.09 sum of the 1st Decile values.
For <20-41>, BN20 =20, CB20=2.94 sum of the 1st Decile values.

(6) For <5-41>, BN5 =5, CG5 =1.00 sum of the 1st Decile values.
For <15-41>, BN15 =15, CG15 =1.00 sum of the 1st Decile values.
For <20-41>, BN20 =20, CG20=1.00 sum of the 1st Decile values.

3) Column CN
a) (Blank)
i) Unused column

4) Cell CO1 – CX1
i) Decile Numbers
(6) Column labels. Each cell of this range contains (Decile#n), (Decile#n+1)…, to form the label for each Decile.
b) Cells BB2 – BB41
i) 1, 2, 3, … 10

5) Cells COn - CXn
a) Decile calculation for each Ward election
i) Each cell contains the conversion of the Candidate election results to the value appropriate for each Decile. Examples will be given for each Candidate field size.
(6) Candidate field sizes will used followed by each Decile calculation. The intent was to make these calculations as simple and straightforward as possible. This is not elegant solution using indirect addressing

(7) =0.2*$F2
=0.2*$F2
=0.2*$F2
=0.2*$F2
=0.2*$F2
=0.2*$G2
=0.2*$G2
=0.2*$G2
=0.2*$G2
=0.2*$G2

(8) =$F106*3/10
=$F106*3/10
=$F106*3/10
=$F106*1/10+$G106*2/10
=$G106*3/10
=$G106*3/10
=$G106*2/10+$H106*1/10
=$H106*3/10
=$H106*3/10
=$H106*3/10

(9) =$F228*4/10
=$F228*4/10
=$F228*2/10+$G228*2/10

=$G228*4/10
=$G228*4/10
=$H228*4/10
=$H228*4/10
=$H228*2/10+$I228*2/10
=$I228*4/10
=$I228*4/10
(10)=$F328*5/10
=$F328*5/10
=$G328*5/10
=$G328*5/10
=$H328*5/10
=$H328*5/10
=$I328*5/10
=$I328*5/10
=$J328*5/10
=$J328*5/10
(11)=$F413*6/10
=$F413*4/10+$G413*2/10
=$G413*6/10
=$G413*2/10+$H413*4/10
=$H413*6/10
=$I413*6/10
=$I413*4/10+$J413*2/10
=$J413*6/10
=$J413*2/10+$K413*4/10
=$K413*6/10
(12)=$F490*7/10
=$F490*3/10+$G490*4/10
=$G490*6/10+$H490*1/10
=$H490*7/10
=$H490*2/10+$I490*5/10
=$I490*5/10+$J490*2/10
=$J490*7/10
=$J490*1/10+$K490*6/10
=$K490*4/10+$L490*3/10
=$L490*7/10
(13)=$F553*8/10
=$F553*2/10+$G553*6/10
=$G553*4/10+$H553*4/10
=$H553*6/10+$I553*2/10
=$I553*8/10
=$J553*8/10
=$J553*2/10+$K553*6/10
=$K553*4/10+$L553*4/10
=$L553*6/10+$M553*2/10
=$M553*8/10

(14)=$F616*9/10
=$F616*1/10+$G616*8/10
=$G616*2/10+$H616*7/10
=$H616*3/10+$I616*6/10
=$I616*4/10+$J616*5/10
=$J616*5/10+$K616*4/10
=$K616*6/10+$L616*3/10
=$L616*7/10+$M616*2/10
=$M616*8/10+$N616*1/10
=$N616*9/10
(15)=$F661
=$G661
=$H661
=$I661
=$J661
=$K661
=$L661
=$M661
=$N661
=$O661
(16)=$F713+$G713*1/10
=$G713*9/10+$H713*2/10
=$H713*8/10+$I713*3/10
=$I713*7/10+$J713*4/10
=$J713*6/10+$K713*5/10
=$K713*5/10+$L713*6/10
=$L713*4/10+$M713*7/10
=$M713*3/10+$N713*8/10
=$N713*2/10+$O713*9/10
=$O713*1/10+$P713
(17)=$F759+$G759*2/10
=$G759*8/10+$H759*4/10
=$H759*6/10+$I759*6/10
=$I759*4/10+$J759*8/10
=$J759*2/10+$K759
=$L759+$M759*2/10
=$M759*8/10+$N759*4/10
=$N759*6/10+$O759*6/10
=$O759*4/10+$P759*8/10
=$P759*2/10+$Q759
(18)=$F798+$G798*3/10
=$G798*7/10+$H798*6/10
=$H798*4/10+$I798*9/10
=$I798*1/10+$J798+$K798*2/10
=$K798*8/10+$L798*5/10
=$L798*5/10+$M798*8/10
=$M798*2/10+$N798+$O798*1/10
=$O798*9/10+$P798*4/10

=$P798*6/10+$Q798*7/10
=$Q798*3/10+$R798
(19)=$F835+$G835*4/10
=$G835*6/10+$H835*8/10
=$H835*2/10+$I835+$J835*2/10
=$J835*8/10+$K835*6/10
=$K835*4/10+$L835
=$M835+$N835*4/10
=$N835*6/10+$O835*8/10
=$O835*2/10+$P835+$Q835*2/10
=$Q835*8/10+$R835*6/10
=$R835*4/10+$S835
(20)=$F864+$G864*5/10
=$G864*5/10+$H864
=$I864+$J864*5/10
=$J864*5/10+$K864
=$L864+$M864*5/10
=$M864*5/10+$N864
=$O864+$P864*5/10
=$P864*5/10+$Q864
=$R864+$S864*5/10
=$S864*5/10+$T864
(21)=$F887+$G887*6/10
=$G887*4/10+$H887+$I887*2/10
=$I887*8/10+$J887*8/10
=$J887*2/10+$K887+$L887*4/10
=$L887*6/10+$M887
=$N887+$O887*6/10
=$O887*4/10+$P887+$Q887*2/10
=$Q887*8/10+$R887*8/10
=$R887*2/10+$S887+$T887*4/10
=$T887*6/10+$U887
(22)=$F902+$G902*7/10
=$G902*3/10+$H902+$I902*4/10
=$I902*6/10+$J902+$K902*1/10
=$K902*9/10+$L902*8/10
=$L902*2/10+$M902+$N902*5/10
=$N902*5/10+$O902+$P902*2/10
=$P902*8/10+$Q902*9/10
=$Q902*1/10+$R902+$S902*6/10
=$S902*4/10+$T902+$U902*3/10
=$U902*7/10+$V902
(23)=$F917+$G917*8/10
=$G917*2/10+$H917+$I917*6/10
=$I917*4/10+$J917+$K917*4/10
=$K917*6/10+$L917+$M917*2/10
=$M917*8/10+$N917
=$O917+$P917*8/10

=$P917*2/10+$Q917+$R917*6/10
=$R917*4/10+$S917+$T917*4/10
=$T917*6/10+$U917+$V917*2/10
=$V917*8/10+$W917
(24)=$F931+$G931*9/10
=$G931*1/10+$H931+$I931*8/10
=$I931*2/10+$J931+$K931*7/10
=$K931*3/10+$L931+$M931*6/10
=$M931*4/10+$N931+$O931*5/10
=$O931*5/10+$P931+$Q931*4/10
=$Q931*6/10+$R931+$S931*3/10
=$S931*7/10+$T931+$U931*2/10
=$U931*8/10+$V931+$W931*1/10
=$W931*9/10+$X931
(25)=$F943+$G943
=$H943+$I943
=$J943+$K943
=$L943+$M943
=$N943+$O943
=$P943+$Q943
=$R943+$S943
=$T943+$U943
=$V943+$W943
=$X943+$Y943
(26)=$F953+$G953+$H953*1/10
=$H953*9/10+$I953+$J953*2/10
=$J953*8/10+$K953+$L953*3/10
=$L953*7/10+$M953+$N953*4/10
=$N953*6/10+$O953+$P953*5/10
=$P953*5/10+$Q953+$R953*6/10
=$R953*4/10+$S953+$T953*7/10
=$T953*3/10+$U953+$V953*8/10
=$V953*2/10+$W953+$X953*9/10
=$X953*1/10+$Y953+$Z953
(27)=$H960*8/10+$I960+$J960*4/10
=$J960*6/10+$K960+$L960*6/10
=$L960*4/10+$M960+$N960*8/10
=$N960*2/10+$O960+$P960
=$Q960+$R960+$S960*2/10
=$S960*8/10+$T960+$U960*4/10
=$U960*6/10+$V960+$W960*6/10
=$W960*4/10+$X960+$Y960*8/10
=$Y960*2/10+$Z960+$AA960
(28)=$F965+$G965+$H965*3/10
=$H965*7/10+$I965+$J965*6/10
=$J965*4/10+$K965+$L965*9/10
=$L965*1/10+$M965+$N965+$O965*2/100
=$O965*8/10+$P965+$Q965*5/10

=$Q965*5/10+$R965+$S965*8/10
=$S965*2/10+$T965+$U965+$V965*1/10
=$V965*9/10+$W965+$X965*4/10
=$X965*6/10+$Y965+$Z965*7/10
=$Z965*3/10+$AA965+$AB965
(29)=$F968+$G968+$H968*4/10
=$H968*6/10+$I968+$J968*8/10
=$J968*2/10+$K968+$L968+$M968*2/10
=$M968*8/10+$N968+$O968*6/10
=$O968*4/10+$P968+$Q968
=$R968+$S968+$T968*4/10
=$T968*6/10+$U968+$V968*8/10
=$V968*2/10+$W968+$X968+$Y968*2/10
=$Y968*8/10+$Z968+$AA968*6/10
=$AA968*4/10+$AB968+$AC968
(30)=$F971+$G971+$H971*5/10
=$H971*5/10+$I971+$J971
=$K971+$L971+$M971*5/10
=$M971*5/10+$N971+$O971
=$P971+$Q971+$R971*5/10
=$R971*5/10+$S971+$T971
=$U971+$V971+$W971*5/10
=$W971*5/10+$X971+$Y971
=$Z971+$AA971+$AB971*5/10
=$AB971*5/10+$AC971+$AD971
(31)=$F974+$G974+$H974*6/10
=$H974*4/10+$I974+$J974+$K974*2/10
=$K974*8/10+$L974+$M974*8/10
=$M974*2/10+$N974+$O974+$P974*4/10
=$P974*6/10+$Q974+$R974
=$S974+$T974+$U974*6/10
=$U974*4/10+$V974+$W974+$X974*2/10
=$X974*8/10+$Y974+$Z974*8/10
=$Z974*2/10+$AA974+$AB974+$AC974*4/10
=$AC974*6/10+$AD974+$AE974
(32)=$F975+$G975+$H975*7/10
=$H975*3/10+$I975+$J975+$K975*4/10
=$K975*6/10+$L975+$M975+$N975*1/10
=$N975*9/10+$O975+$P975*8/10
=$P975*2/10+$Q975+$R975+$S975*5/10
=$S9750*5/10+$T975+$U975+$V975*2/10
=$V975*8/10+$W975+$X975*9/10
=$X975*1/10+$Y975+$Z975+$AA975*6/10
=$AA975*4/10+$AB975+$AC975+$AD975*3/10
=$AD975*7/10+$AE975+$AF975
(33)=$F976+$G976+$H976*8/10
=$H976*2/10+$I976+$J976+$K976*6/10
=$K976*4/10+$L976+$M976+$N976*4/10

=$N976*6/10+$O976+$P976+$Q976*2/10
=$Q976*8/10+$R976+$S976
=$T976+$U976+$V976*8/10
=$V976*2/10+$W976+$X976+$Y976*6/10
=$Y976*4/10+$Z976+$AA976+$AB976*4/10
=$AB976*6/10+$AC976+$AD976+$AE976*2/10
=$AE976*8/10+$AF976+$AG976
(34)=$F978+$G978+$H978*9/10
=$H978*1/10+$I978+$J978+$K978*8/10
=$K978*2/10+$L978+$M978+$N978*7/10
=$N978*3/10+$O978+$P978+$Q978*6/10
=$Q978*4/10+$R978+$S978+$T978*5/10
=$T978*0.5/10+$U978+$V978+$W978*4/10
=$W978*6/10+$X978+$Y978+$Z978*3/10
=$Z978*7/10+$AA978+$AB978+$AC978*2/10
=$AC978*8/10+$AD978+$AE978+$AF978*1/10
=$AF978*9/10+$AG978+$AH978
(35)=$F980+$G980+$H980
=$I980+$J980+$K980
=$L980+$M980+$N980
=$O980+$P980+$Q980
=$R980+$S980+$T980
=$U980+$V980+$W980 0
=$X980+$Y980+$Z980
=$AA980+$AB980+$AC980
=$AD980+$AE980+$AF980
=$AG980+$AH980+$AI980
(35)=$F981+$G981+$H981+$I981*5/10
=$I981*5/10+$J981+$K981+$L981
=$M981+$N981+$O981+$P981*5/10
=$P981*5/10+$Q981+$R981+$S981
=$T981+$U981+$V981+$W981*5/10
=$W981*5/10+$X981+$Y981+$Z981
=$AA981+$AB981+$AC981+$AD981*5/10
=$AD981*5/10+$AE981+$AF981+$AG981
=$AH981+$AI981+$AJ981+$AK981*5/10
=$AK981*5/10+$AL981+$AM981+$AN981
(38)=$F982+$G982+$H982+$I982*8/10
=$I982*2/10+$J982+$K982+$L982+$M982*6/10
=$M982*4/10+$N982+$O982+$P982+$Q982*4/10
=$Q982*6/10+$R982+$S982+$T982+$U982*2/10
=$U982*8/10+$V982+$W982+$X982
=$Y982+$Z982+$AA982+$AB982*8/10
=$AB982*2/10+$AC982+$AD982+$AE982+$AF982*6/10
=$AF982*4/10+$AG982+$AH982+$AI982+$AJ982*4/10
=$AJ982*6/10+$AK982+$AL982+$AM982+$AN982*2/10
=$AN982*8/10+$AO982+$AP982+$AQ982

(39)=$F983+$G983+$H983+$I983*9/10
=$I983*1/10+$J983+$K983+$L983+$M983*8/10
=$M983*2/10+$N983+$O983+$P983+$Q983*7/10
=$Q983*3/10+$R983+$S983+$T983+$U983*6/10
=$U983*4/10+$V983+$W983+$X983+$Y983*5/10
=$Y983*5/10+$Z983+$AA983+$AB983+$AC983*4/10
=$AC983*6/10+$AD983+$AE983+$AF983+$AG983*3/10
=$AG983*7/10+$AH983+$AI983+$AJ983+$AK983*2/10
=$AK983*8/10+$AL983+$AM983+$AN983+$AO983*1/10
=$AO983*9/10+$AP983+$AQ983+$AR983
(41)=$F984+$G984+$H984+$I984+$J984*1/10
=$J984*9/10+$K984+$L984+$M984+$N984*2/10
=$N984*8/10+$O984+$P984+$Q984+$R984*3/10
=$R984*7/10+$S984+$T984+$U984+$V984*4/10
=$V984*6/10+$W984+$X984+$Y984+$Z984*5/10
=$Z984*5/10+$AA984+$AB984+$AC984+$AD984*6/10
=$AD984*4/10+$AE984+$AF984+$AG$984+$AH984*7/10
=$AH984*3/10+$AI984+$AJ984+$AK984+$AL984*8/10
=$AL984*2/10+$AM984+$AN984+$AO984+$AP984*9/10
=$AP984*1/10+$AQ984+$AR984+$AS984+AT984

Single Vacancy Election Calculations

Table5 and Table 12 can be built using the same technique as the Observed and Expected Probabilities but limited to the special case of single member wards. Construction of these tables is left as an exercise.