

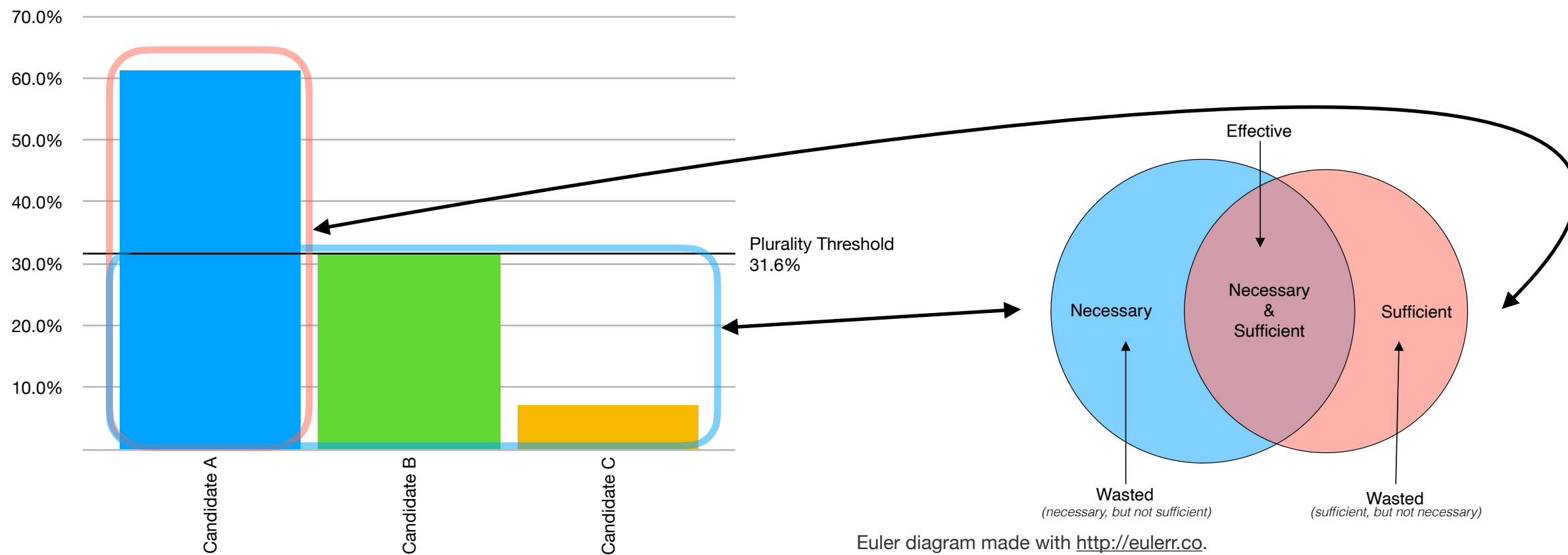
Example calculations of wasted votes (plurality)

1	Votes	Necessary	Sufficient	Wasted	Wasted %	Effective	Effective %	Ballot %
Candidate A	6000	3101	6000	2899	48.3%	3101	51.7%	61.2%
Candidate B	3100	3100	0	3100	100.0%	0	0.0%	31.6%
Candidate C	701	701	0	701	100.0%	0	0.0%	7.2%
Total	9801	6902	6000	6700	68.4%	3101	31.6%	100%

A wasted vote is any vote that is either not necessary **OR** not sufficient to elect a candidate.

An effective vote is any vote that is both necessary **AND** sufficient to elect a candidate.

$$(\forall x)\{Vx \rightarrow [Wx \leftrightarrow (x \notin N \vee x \notin S)]\}$$



Euler diagram made with <http://eulerr.co>.
 Larsson J (2020). *eulerr: Area-Proportional Euler and Venn Diagrams with Ellipses*. R package version 6.1.0, <https://cran.r-project.org/package=eulerr>.

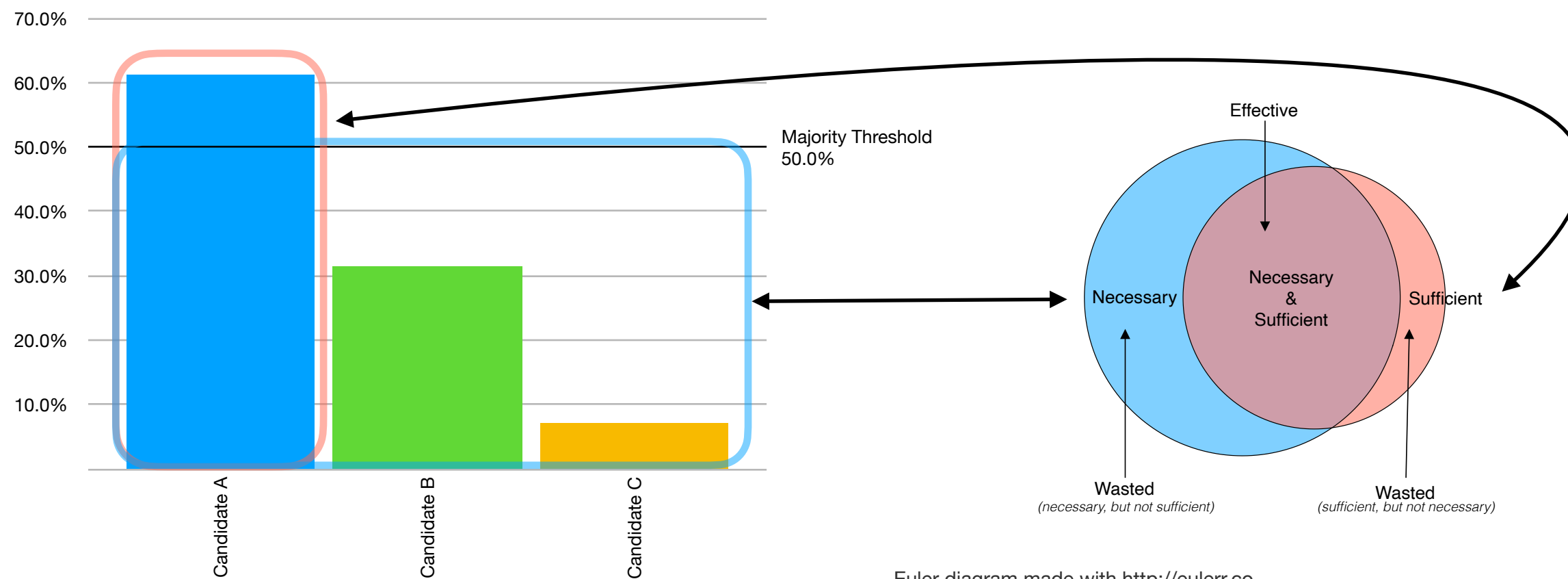
Example calculations of wasted votes (majority)

9801	Votes	Necessary	Sufficient	Wasted	Wasted %	Effective	Effective %	Ballot %
Candidate A	6000	4901	6000	1099	18.3%	4901	81.7%	61.2%
Candidate B	3100	3100	0	3100	100.0%	0	0.0%	31.6%
Candidate C	701	701	0	701	100.0%	0	0.0%	7.2%
Total	9801	8702	6000	4900	49.99%	4901	50.01%	100%

A wasted vote is any vote that is either not necessary **OR** not sufficient to elect a candidate.

An effective vote is any vote that is both necessary **AND** sufficient to elect a candidate.

$$(\forall x)\{Vx \rightarrow [Wx \leftrightarrow (x \notin N \vee x \notin S)]\}$$



Euler diagram made with <http://eulerr.co>.
 Larsson J (2020). *eulerr: Area-Proportional Euler and Venn Diagrams with Ellipses*. R package version 6.1.0, <https://cran.r-project.org/package=eulerr>.

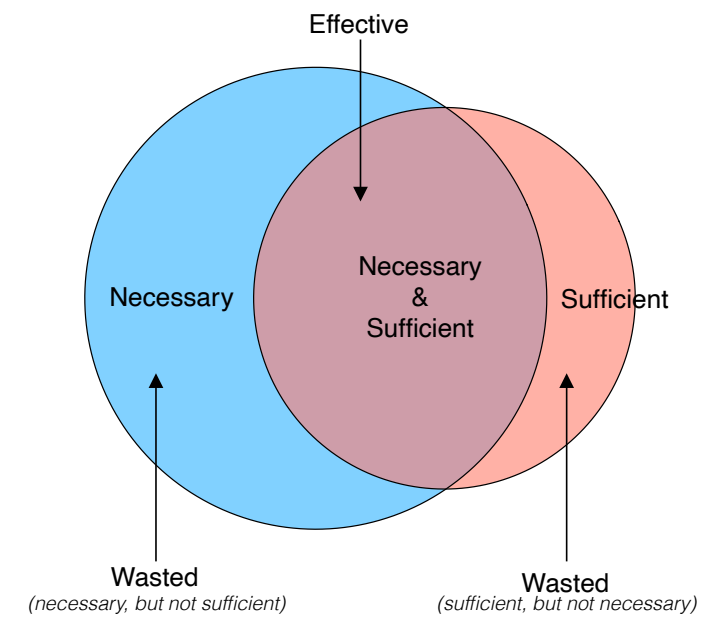
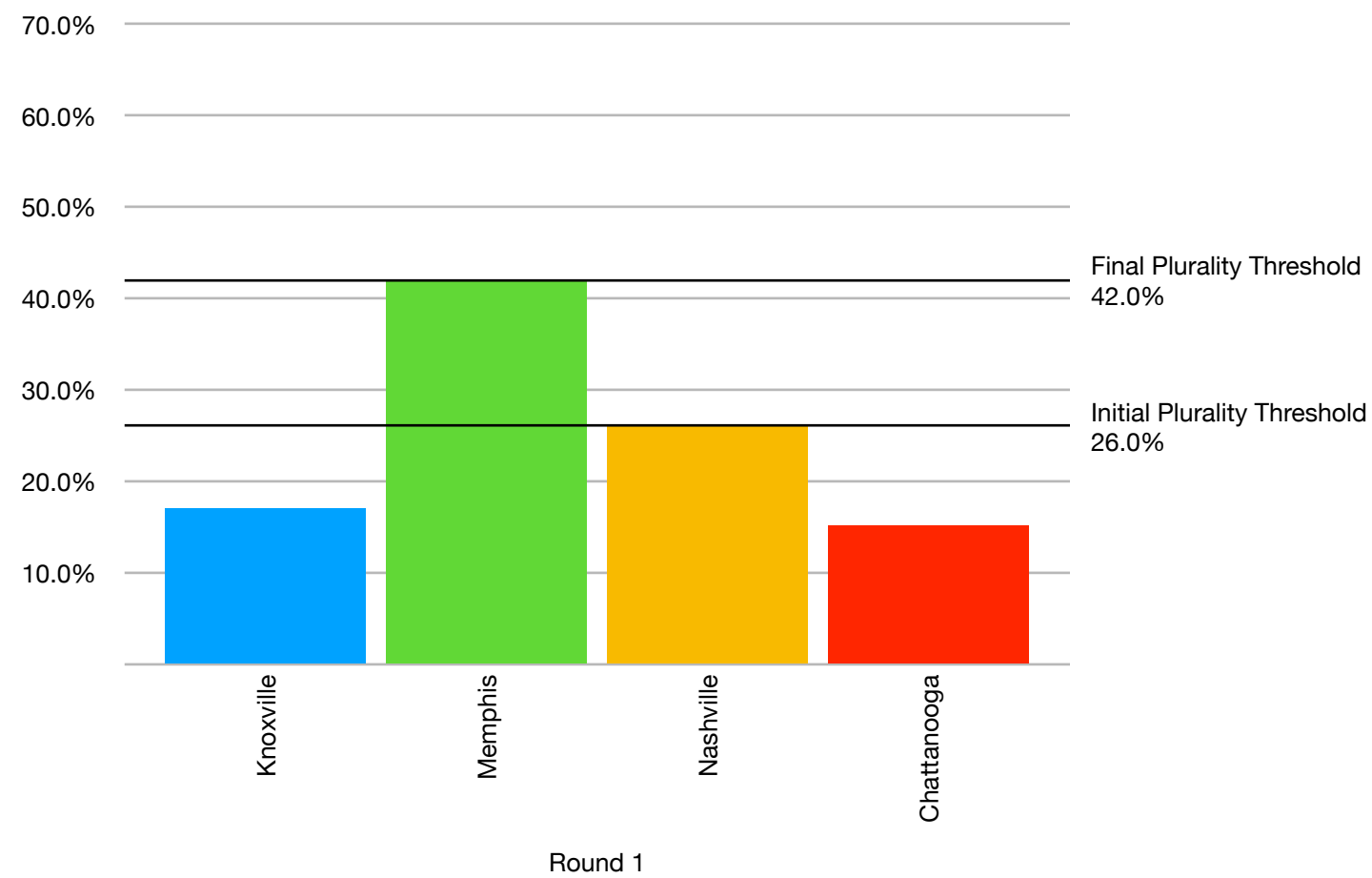
Tennessee capital election

	Round 1		Round 2		Round 3	
	Votes	%	Votes	%	Votes	%
Knoxville	17	17.0%	32	32.0%	58	58.0%
Memphis	42	42.0%	42	42.0%	42	42.0%
Nashville	26	26.0%	26	26.0%		0.0%
Chattanooga	15	15.0%		0.0%		0.0%
Total	100	100.0%	100	100.0%	100	100.0%

Calculations of wasted votes (final round)

1	Votes	Necessary	Sufficient	Wasted	Wasted %	Effective	Effective %	Ballot %
Knoxville	58	43	58	15	25.9%	43	74.1%	58.0%
Memphis	42	42	0	42	100.0%	0	0.0%	42.0%
Total	100	85	58	57	57.0%	43	43.0%	100%

Taken from [Wikipedia's article on Instant-runoff voting](#).

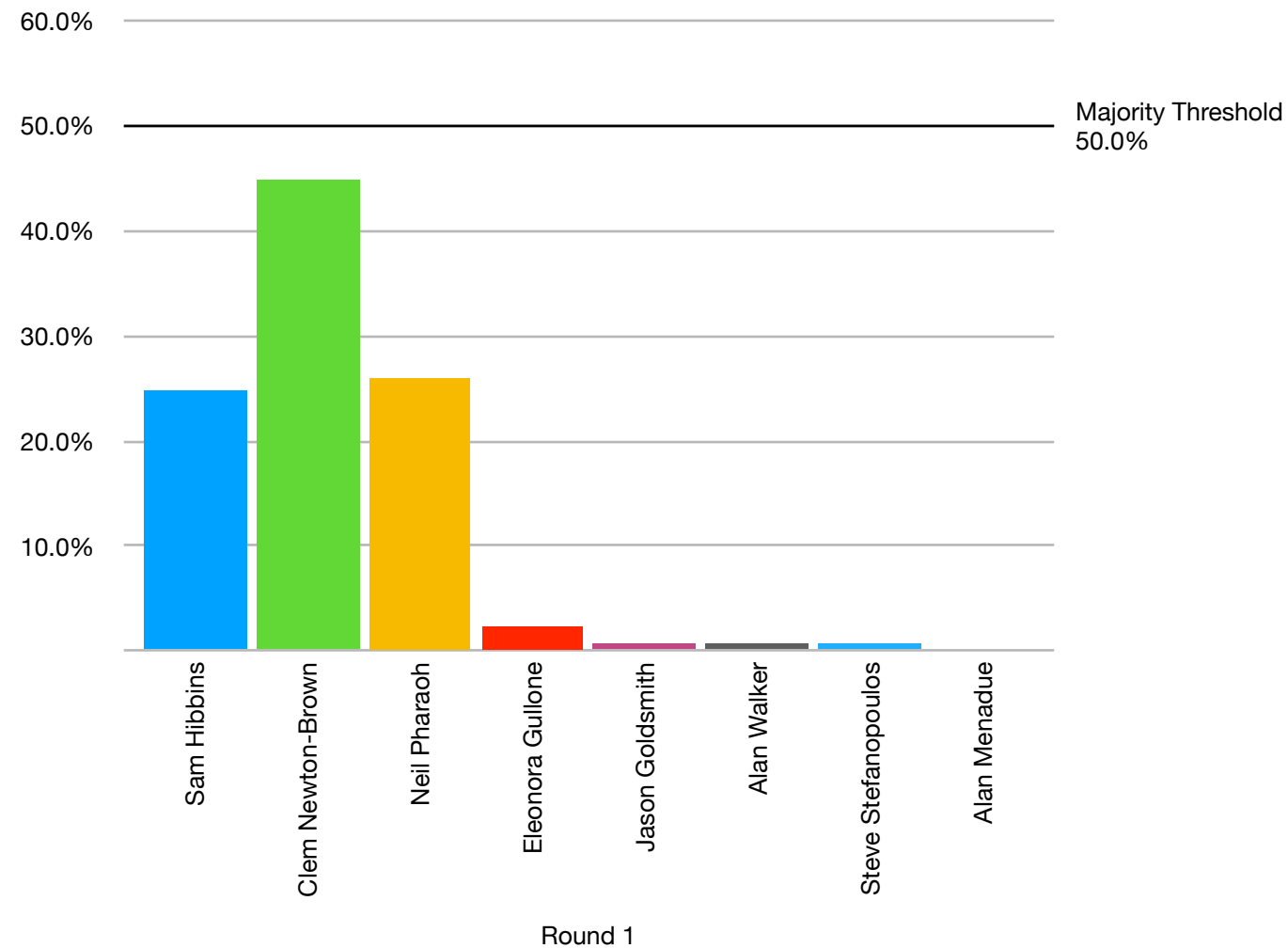


Euler diagram made with <http://eulerr.co>.
 Larsson J (2020). *eulerr: Area-Proportional Euler and Venn Diagrams with Ellipses*. R package version 6.1.0, <https://cran.r-project.org/package=eulerr>.

2014 Prahran election (Victoria)

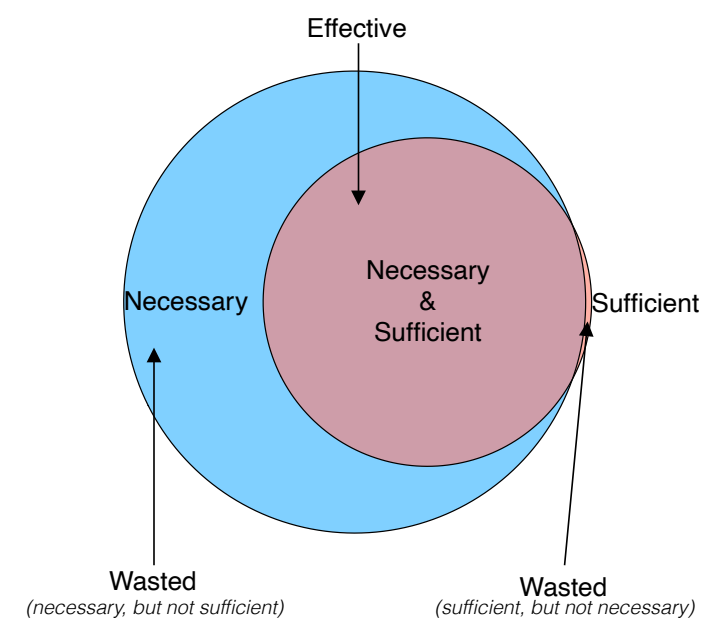
	Round 1		Round 2		Round 3		Round 4		Round 5		Round 6		Round 7	
	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%
Sam Hibbins	9160	24.8%	9171	24.8%	9218	24.9%	9310	25.2%	9403	25.4%	9979	27.0%	18640	50.4%
Clem Newton-Brown	16582	44.8%	16592	44.8%	16644	45.0%	16726	45.2%	16843	45.5%	17076	46.1%	18363	49.6%
Neil Pharaoh	9586	25.9%	9593	25.9%	9639	26.0%	9690	26.2%	9758	26.4%	9948	26.9%		
Eleonora Gullone	837	2.3%	860	2.3%	891	2.4%	928	2.5%	999	2.7%				
Jason Goldsmith	247	0.7%	263	0.7%	316	0.9%	349	0.9%						
Alan Walker	282	0.8%	283	0.8%	295	0.8%								
Steve Stefanopoulos	227	0.6%	241	0.7%										
Alan Menadue	82	0.2%												
Total	37003	100.0%	37003	100.0%	37003	100.0%	37003	100.0%	37003	100.0%	37003	100.0%	37003	100.0%

Taken from [Wikipedia's article on Instant-runoff voting](#).



Calculations of wasted votes (final round)

37003	Votes	Necessary	Sufficient	Wasted	Wasted %	Effective	Effective %	Ballot %
Candidate A	18640	18502	18640	138	0.7%	18502	99.3%	50.4%
Candidate B	18363	18363	0	18363	100.0%	0	0.0%	49.6%
Total	37003	36865	18640	18501	49.999%	18502	50.001%	100%



Euler diagram made with <http://eulerr.co>.
 Larsson J (2020). *eulerr: Area-Proportional Euler and Venn Diagrams with Ellipses*. R package version 6.1.0, <https://cran.r-project.org/package=eulerr>.

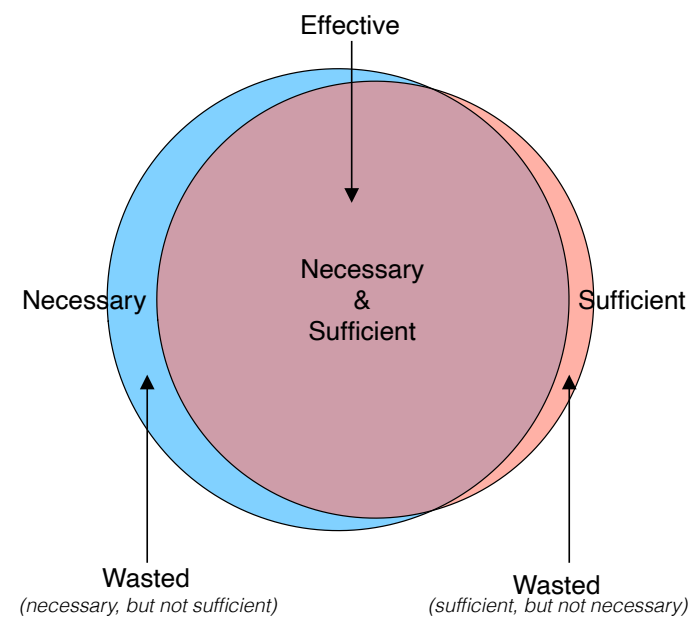
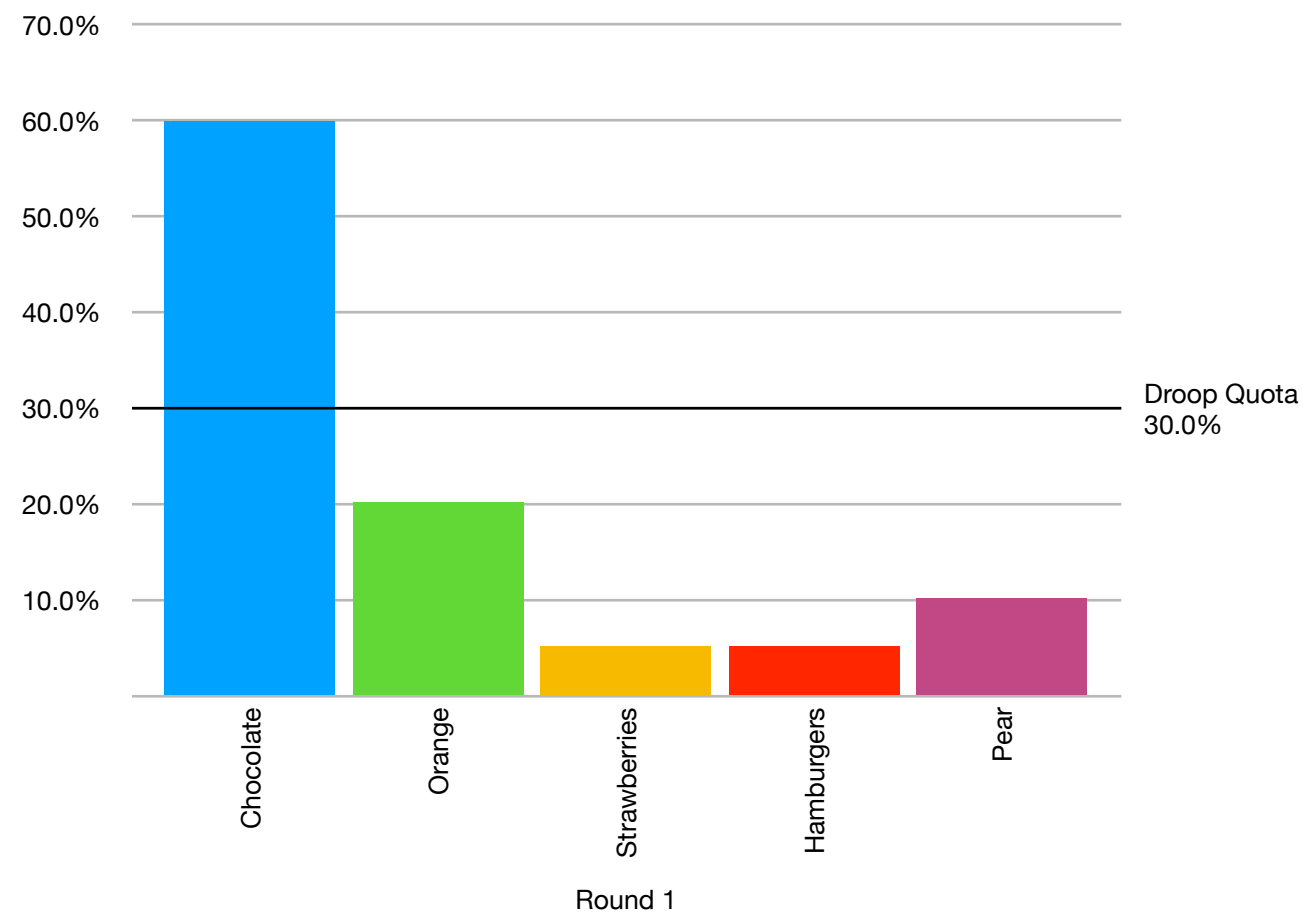
Example election

	Round 1		Round 2		Round 3		Round 4	
	Votes	%	Votes	%	Votes	%	Votes	%
Chocolate	12	60.0%	6	30.0%	6	30.0%	6	30.0%
Orange	4	20.0%	4	20.0%	6	30.0%	6	30.0%
Strawberries	1	5.0%	5	25.0%	5	25.0%	5	25.0%
Hamburgers	1	5.0%	3	15.0%	3	15.0%	3	15.0%
Pear	2	10.0%	2	10.0%	0	0.0%	0	0.0%
Total	20	100.0%	20	100.0%	20	100.0%	20	100.0%

Calculations of wasted votes (final round)

20	Votes	Necessary	Sufficient	Wasted	Wasted %	Effective	Effective %	Ballot %
Chocolate	6	6	6	0	0%	6	100%	30%
Orange	6	6	6	0	0%	6	100%	30%
Strawberries	5	4	5	1	20%	4	80%	25%
Hamburgers	3	3	0	3	100%	0	0%	15%
Pear	0	0	0	0	0%	0	0%	0%
Total	20	19	17	4	20%	16	80%	100%

Taken from the [Wikipedia single transferable vote example](#).



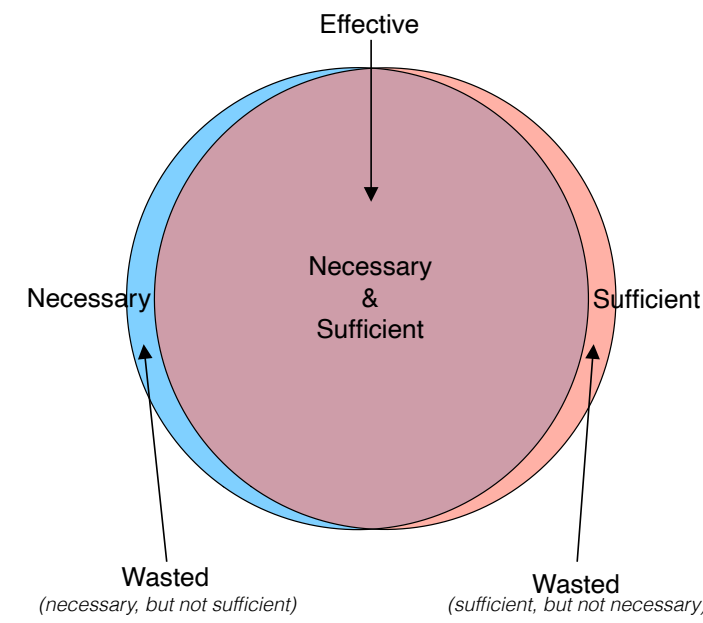
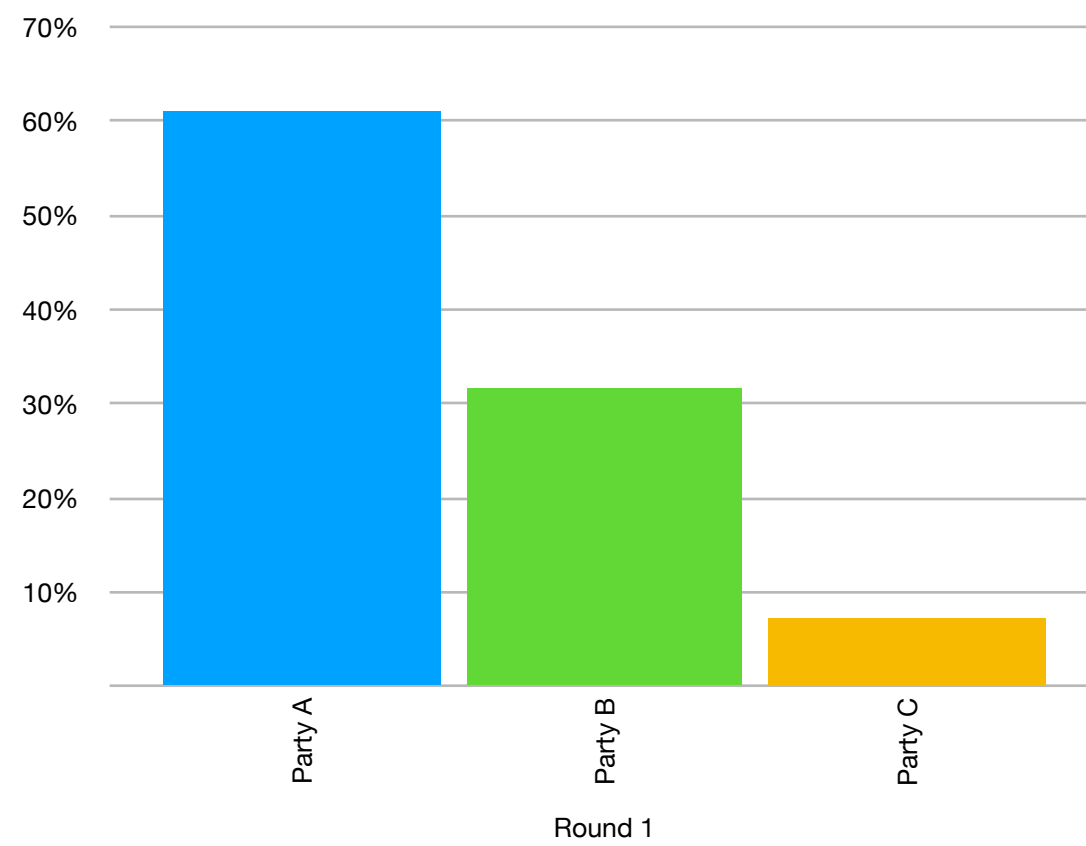
Euler diagram made with <http://eulerr.co>.
 Larsson J (2020). *eulerr: Area-Proportional Euler and Venn Diagrams with Ellipses*. R package version 6.1.0, <https://cran.r-project.org/package=eulerr>.

Example election (D'Hondt)

	Votes	Round 1		Round 2		Round 3		Round 4		Round 5		Round 6		Round 7		Round 8		Round 9		Round 10		Round 11		Round 12		Seats		Ballots	
		Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Votes	%	Won	%	%	
Party A	6000	6000	61%	3000	44%	3000	57%	2000	47%	1500	40%	1500	46%	1200	41%	1000	37%	1000	40%	857	37%	750	34%	750	36%	8	66.7%	61.2%	
Party B	3100	3100	32%	3100	46%	1550	30%	1550	36%	1550	41%	1033	32%	1033	35%	1033	38%	775	31%	775	33%	775	35%	620	30%	4	33.3%	31.6%	
Party C	701	701	7%	701	10%	701	13%	701	16%	701	19%	701	22%	701	24%	701	26%	701	28%	701	30%	701	31%	701	34%	0	0.0%	7.2%	
Total	9801	9801	100%	6801	100%	5251	100%	4251	100%	3751	100%	3234	100%	2934	100%	2734	100%	2476	100%	2333	100%	2226	100%	2071	100%	12	100.0%	100.0%	

Example calculations of wasted votes (D'Hondt)

	Votes	Necessary	Sufficient	Wasted	Wasted %	Effective	Effective %	Ballot %
Party A	6000	5609	6000	391	6.5%	5609	93.5%	61.2%
Party B	3100	2804	3100	296	9.5%	2804	90.5%	31.6%
Party C	701	701	0	701	100.0%	0	0.0%	7.2%
Total	9801	9114	9100	1388	14.2%	8413	85.8%	100%



Euler diagram made with <http://eulerr.co>.
 Larsson J (2020). *eulerr: Area-Proportional Euler and Venn Diagrams with Ellipses*. R package version 6.1.0, <https://cran.r-project.org/package=eulerr>.