

# Ranked-Choice Voting

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**Ranked-Choice Voting in Maine Congressional District 2: Nov. 6, 2018.**

The data are published on a Maine Secretary of State website.

[Click Here](#)“Certified Updated Results”

[Click Here](#)“Ranked-Choice Rules”

## Load libraries

```
suppressMessages(library(readr)) # fast load
suppressMessages(library(dplyr)) # filter

rm(list = ls())
path <- "https://raw.githubusercontent.com/damonzon/Ranked_Choice_Voting_Maine/master/MaineTidyData2018.csv"
data <- read_csv(path)
start <- Sys.time()
data <- filter(data, first != "overvote")
table(data$first)
```

```
##
##      Bond      Golden      Hoar Poliquin undervote
##      16415     131822      6782   133993         6641
```

```
round(prop.table(table(data$first)), 4)
```

```
##
##      Bond      Golden      Hoar Poliquin undervote
##      0.0555     0.4459     0.0229   0.4532     0.0225
```

**Write functions to shift column data to the left**

```
shift_left <- function(x) {
  shift$first <- shift$second
  shift$second <- shift$third
  shift$third <- shift$fourth
  shift$fourth <- shift$fifth
  shift$fifth <- "undervote"
}
```

```

shift_under <- function(x) {
  shift_left(shift)
  not_under <- filter(shift, first != "undervote")
  shift <- filter(shift, first == "undervote")
  shift_left(shift)
  shift <- rbind(not_under, shift)
  shift <- filter(shift, first != "undervote")
}

continue <- filter(data, first != "undervote")
table(continue$first)

##
##      Bond      Golden      Hoar Poliquin
##      16415     131822      6782    133993

shift <- filter(data, first == "undervote")
shift_left(shift)
shift <- filter(shift, first != "undervote" & first != "overvote")
continue <- rbind(continue, shift)

```

## Round 1 Results

```

table(continue$first)

##
##      Bond      Golden      Hoar Poliquin
##      16552     132013      6875    134184

round(prop.table(table(continue$first)), 4)

##
##      Bond      Golden      Hoar Poliquin
##      0.0571     0.4558     0.0237     0.4633

```

The vote totals are identical to those in the updated certified report.

Poliquin with 134184 votes, led in Round 1 with 46.3%. According to the rules of ranked-choice voting, to be declared a winner, a candidate had to have at least as many votes as the winning threshold.

```

Poliquin <- nrow(filter(continue, first == "Poliquin"))
WT <- nrow(continue) * 0.5 + 1
cat("The winning threshold was", WT, "continuing votes")

## The winning threshold was 144813 continuing votes
cat("Poliquin fell short of winning by", WT - Poliquin, "votes")

## Poliquin fell short of winning by 10629 votes

```

So we proceed to the next round by dropping the candidate with the fewest votes: Hoar.

```
shift <- filter(continue, first == "Hoar")
shift_under(shift)
shift <- filter(shift, first != "undervote")
right1 <- shift
table(right1$first)
```

```
##
##      Bond      Golden      Hoar overvote Poliquin
##      2606       1194       141       21       886
```

```
shift <- filter(right1, first == "Hoar")
shift_under(shift)
shift <- filter(shift, first != "undervote")
right2 <- shift
table(right2$first)
```

```
##
##      Bond      Golden      Hoar Poliquin
##        11         8       106         2
```

```
shift <- filter(right2, first == "Hoar")
shift_under(shift)
shift <- filter(shift, first != "undervote")
right3 <- shift
table(right3$first)
```

```
##
##      Bond      Golden      Hoar Poliquin
##         2         1       98         1
```

```
shift <- filter(right3, first == "Hoar")
shift_under(shift)
shift <- filter(shift, first != "undervote")
right4 <- shift
table(right4$first)
```

```
##
## Bond Hoar
##   2   93
```

```
continue <- rbind(continue, right1, right2,
                  right3, right4)
continue <- filter(continue,
                  first != "Hoar")
continue <- filter(continue,
                  first != "overvote")
```

## Results after dropping Hoar

```
table(continue$first)

##
##      Bond      Golden Poliquin
##    19173    133216    135073

round(prop.table(table(continue$first)), 4)

##
##      Bond      Golden Poliquin
##    0.0667    0.4634    0.4699
```

All three remaining candidates gained votes from the alternative choices of the Hoar voters. Now Poliquin led with 47.0 to 46.3 for Golden, but the tally was still less than 50% +1.

```
Poliquin <- nrow(filter(continue, first == "Poliquin"))
WT <- nrow(continue) * 0.5 + 1
cat("The winning threshold was", WT, "continuing votes")

## The winning threshold was 143732 continuing votes
cat("Poliquin fell short of winning by", WT - Poliquin, "votes")

## Poliquin fell short of winning by 8659 votes
```

So we now remove Bond votes and continue the analysis.

```
data <- continue
continue <- filter(data, first != "Bond")
shift <- filter(data, first == "Bond" | first == "Hoar")
shift_under(shift)
right1 <- filter(shift, first != "overvote")
shift <- filter(right1, first == "Bond" | first == "Hoar")
shift_under(shift)
right2 <- filter(shift, first != "overvote")
shift <- filter(right2, first == "Bond" | first == "Hoar")
shift_under(shift)
right3 <- filter(shift, first != "overvote")
shift <- filter(right3, first == "Bond" | first == "Hoar")
shift_under(shift)
right4 <- filter(shift, first != "overvote")
continue <- rbind(continue, right1, right2, right3, right4)
continue <- filter(continue, first != "Bond" & first != "Hoar")
```

```
table(continue$first)

##
##   Golden Poliquin
##   142440   138931

round(prop.table(table(continue$first)), 4)

##
##   Golden Poliquin
##   0.5062   0.4938

end <- Sys.time()
round(end - start,3)

## Time difference of 0.888 secs
```

## Final Results

The ranked-choice process has produced a clear winner. Golden now has 142440 (50.62%) of the continuing votes, compared to 138931 (49.38%) for Poliquin.

```
Golden<- nrow(filter(continue, first == "Golden"))
WT <- round(nrow(continue) * 0.5 + 1)
cat("The winning threshold was", WT, "continuing votes")

## The winning threshold was 140686 continuing votes

cat("Golden exceeded the minimum threshold by",Golden - WT, "votes")

## Golden exceeded the minimum threshold by 1754 votes
```

Some have questioned the validity of the election results, because the software used by the Secretary of State was “propriety”. In other words, we don’t know what it is and what algorithms it used. Thus it was important to demonstrate that “open” software, available to all, can get the identical results, and give voters confidence that the process is fair, accurate and transparent.

The gold standard for data analysis in science, elections, etc. is “Reproducibility”. This analysis was done with the programming language “R”, using Rmarkdown to produce this pdf file. It could also be output to Word and html formats.

Here are results obtained by the “Python” programming language.

[Click Here](#)“Maine Congressional District 2: Replication”

A	B	C	D	E	F	G
Report Name	Summary Report					
Election Name	General Election					
Election Date	11.06.18					
Office Title	Congressional District 2					
	Round 1			Round 2		
Candidate Names	Votes	Percentage	Transfer	Votes	Percentage	Transfer
Bond, Tiffany L.	16552	05.71%	-16552	0	00.00%	0
DEM Golden, Jared F.	132013	45.58%	10427	142440	50.62%	0
Hoar, William R.S.	6875	02.37%	-6875	0	00.00%	0
REP Poliquin, Bruce	134184	46.33%	4747	138931	49.38%	0
Ballot Exhausted						
By Overvotes	435		98	533		0
By Undervotes	6018		7820	13838		0
By Exhausted Choices	0		335	335		0
Continuing Ballots	289624		0	281371		0
TOTAL	296077		0	296077		0
Winning threshold by round	144813			140686		
Generated: 11/21/2018 19:36						
Total = Ballot Exhausted by Overvotes + Ballot Exhausted by Undervotes + Exhausted Ballot + Continuing Ballots						
Winning Threshold = [Continuing ballots/(Vote for [number] +1)] + 1						
"*" symbol signifies elimination due to Tie Resolution.						

Figure 1: Maine Secretary of State Spreadsheet