Adventures in Ranked Choice Voting:
Examining Maine's 2018 Gubernatorial Primary

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Introduction

Maine recently became the first state to implement instant-runoff voting, or ranked choice voting (RCV) in U.S. Senate and House elections. Before a court ruling, the state also successfully conducted RCV primary elections for governor in the summer of 2018. With seven candidates vying for the nomination, and as the first time voters in the state would try RCV, this race offered an opportunity to examine voting behavior to see how voters acted in a new electoral system.

This paper explores three areas of RCV voting through the analysis of Maine's 2018 gubernatorial primary. First, this paper offers a descriptive analysis of the ballots cast in the primary, examining various voting propensities and patterns. Second, the paper attempts to address questions about the confusing nature of RCV by looking broadly at ballot errors. Third, the paper addresses the criticism that RCV does not always guarantee majority winners by examining ballot exhaustion in close detail. As the extant literature on RCV has looked at many of these areas separately, it is worthwhile to examine Maine in a broad context rather than through reexaminations of any one single avenue. Using this method, we can see how the inclusion of new data from Maine might bolster or weaken current arguments about RCV. In sum, voting behavior in Maine seems to be in line with many other studies. Rates of single-shot voting seem to be lower than reported in other locations, suggesting more participation in ranking, but the rate of completely ranked ballots was also lower, likely due to the large number of rankings allowed. Error rates seemed to be in line with other studies, but we find that the

actual effect of any ballot errors was minimal. Finally, the number of completely blank ballots was at the low end of one study, but it is difficult to find comparable data. These blank ballots should be the subject of additional study.

Data and Methods

After the 2018 Maine primaries, the state released ballot images for their RCV elections. Multiple files contained the rankings for all votes cast in the gubernatorial primary. After merging these files, a tabulation of the votes was conducted to ensure the accuracy of the ballot image files. This tabulation was performed by an open source RCV tabulator called the Universal RCV Tabulator. There were some slight variations (three ballots) between undervote counts and exhausted ballots by exhausted candidates, but the overall number of exhausted ballots matched in the first three rounds. In the final round, another three ballots were counted for the winner Janet Mills in the unofficial count, rather than being listed as exhausted in the official count. Unfortunately, it is not clear how to determine which ballots were counted differently, but given the minute variation, later conclusions should not be dramatically affected.

In addition to tabulating the ballot images, I recoded and collapsed the ballots to obtain frequencies of each unique ballot. This recoding produced a unique eight-character code for a ballot, where numbers represented votes for specific candidates (1-7 based on the alphabetical order of the ballot, and 9 for write-ins) and the letters ‘O’ and ‘U’ for overvotes and undervotes. This coding allowed for easier analysis of different voting behaviors.

Voting Propensities

As a purely descriptive exercise, the ballot images for the gubernatorial primary were coded and collapsed to generate frequencies for all 17,513 unique ballot combinations within the 132,250

ballots cast. **Table 1** shows the ten most common ballots. From this table, we can see that one-two- and three-shot ballots were among the most common vote types, however, we also see that a blank ballot was the second most common ballot. Absent from this list are even more common (but also much more varied) ballots that ranked every candidate.

TABLE 1 – Most Common Ballots

Ballot Code	*n*	%
5UUUUUUU	6010	4.5
UUUUUUUU	5535	4.2
1UUUUUUU	4552	3.4
15UUUUUU	1609	1.2
57UUUUUU	1556	1.2
51UUUUUU	1533	1.2
7UUUUUUU	1429	1.1
54UUUUUU	1275	1.0
154UUUUU	1169	0.9
157UUUUU	1131	0.9

One Shot Voting

Of the 17,513 unique ballot combinations, the most common single ballot was a 'one-shot' ballot for Janet Mills, the eventual winner (5UUUUUUU). This ballot marking occurred 6,010 times, or in roughly 4.5 percent of all ballots. This particular ballot marking form (#UUUUUUU) is not the only way to cast a one-shot vote for a candidate, but it was the most popular, representing 11.1 percent of all ballots. Looking at Mills' one-shot votes, we see 22 different combinations that were valid one-shot ballots. Beyond the most popular one, the remaining 21 combinations totaled 424 votes. The second most popular way of one-shot voting was marking Mills as the choice in every ranking spot on the ballot. An additional 10 combinations were invalid ballots, containing too many undervote positions at the beginning of the ballot, or an overvote before a valid ranking. **Table 2** shows an example of the wide range of unique ballots that counted as one-shot votes for Mills.

TABLE 2 - Unique Patterns in One-Shot Voting for Mills

Ballot	Frequency	Ballot	Frequency
5UUUUUUU	6010	5UU5UUUU	2
55555555	276	UUUUU5UU*	2
555UUUUU	51	55005555	1
55UUUUUU*	22	50555555	1
UUUUUUU5	15	505UUUUU	1
U5UUUUUU	13	50000055	1
5UUUUUU0	12	5U00UUUU	1
50UUUUUU	11	5U0UUUUU	1
05UUUUUU*	10	5UUU5UUU	1
5555555U	9	055UUUUU*	1
5555UUUU	8	0005UUUU*	1
UU5UUUUU*	6	U5555555	1
555555UU	4	UUU5UUUU*	1
55555UUU	3	UUUU5UUU*	1
5U5UUUUU	3	UUUU0U50*	1
500UUUUU	2	UUUUU0U5*	1
*Invalid Ballot Marking			

In sum, there were 15,719 valid single-shot ballots (15,881 in total), including one shot votes for write-in candidates. This means that, while they had the opportunity, nearly 12 percent of voters chose not to rank their choices. **Table 3** shows the total number of valid single-shot votes for each candidate. An additional 162 ballots would have been single-shot votes if not for other errors, such as initial undervotes, or overvotes.

TABLE 3 Single-Shot Votes

Candidate	Votes
Cote, Adam Roland	4810
Dion, Donna J.	306
Dion, Mark N.	801
Eves, Mark W.	1179
Mills, Janet T.	6434
Russell, Diane Marie	206
Sweet, Elizabeth A.	1525
Write-In	458

What can be made of these single-shot voting rates? Given that this is a primary, we might expect rates of single-shot balloting to be somewhat less than in multi-party races. Indeed, this rate is less than any of the rates reported in other studies in San Francisco (Neely and Cook 2008), or Washington (Alvarez, Hall, and Levin 2018). However, additional study would be required in order to determine if these single-shot ballots were the product of sincere preferences, or a confusion or other failure of RCV.

Two-Shot Voting

Another common type of ballot was a two-shot ballot, with 14,029 ballots ranking only two candidates (including write-ins and invalid ballots). Of these, there were 13,652 (10.3 percent) valid two-shot ballots, not including those with write-in votes. **Table 4** presents a matrix of the first- and second-vote combinations

Table 4 – Two-Shot Combinations

					Second Vote		
First Vote	1	2	3	4	5	6	7
1		127	324	864	1642	75	764
2	39		25	20	36	10	26
3	102	27		56	194	42	63
4	413	22	78		637	35	660
5	1581	95	522	1308		132	1598
6	28	18	26	19	37		72
7	375	53	91	554	749	113	

In their study of rationality in IRV ballots, Alvarez et al. (2018) reported low rates of rankings that took a form where undervotes separated rankings for two candidates. While the comparisons are not perfect, rates in Maine were similar, with the two shot ballots presented being mostly of the form (##UUUUUU), meaning that there were no undervotes separating the two choices in over 97 percent of two-candidate ballots.

Ranking the Entire Field

While some voters chose not to rank the field, opting instead for single- and two-shot ballots, most Mainers did exercise the opportunity to rank order all of the candidates. 39,622 (30 percent) ballots contained a ranking for every one of the candidates, including 2,273 which also ranked a write-in candidate. This is lower than reported in the Alvarez et al. paper, however Maine has a significantly longer ballot to fill. In looking through these ballots there were also a number of other interesting or unique ballots Interestingly, 288 voters ranked their choices in the same order as they were listed on the ballot (a 'donkey ballot') and 12 did so in reverse order. While the first listed candidate did perform well, he was always well ahead of the next lowest candidate, eliminating any fears that these ordered ballots created an unfair advantage. This rate of donkey voting is much lower than reported rates in Australian elections, the place of origin of the term (Orr, 2002).

Ranking the entire field ended up being the most common voting method, with 30 percent of voters completing their ballot - more common than single- or two-shot voting combined. Table 5 shows the remaining ballots, listing the number of unique candidates ranked as well as the number of ranking positions filled for each ballot.

Table 5 – Ballot Completeness

Number of Unique Candidates Ranked		Number of Ranking Positions Filled	
Candidates	*n*	Positions	*n*
0	5748	0	5535
1	15881	1	15003
2	14029	2	13795
3	27961	3	27988
4	15279	4	15288
5	6568	5	6255
6	5543	6	4472

	7	38968		7	38972
	8	2273		8	4942

Ballot Errors

As a second area of inquiry, it is worthwhile to look at ballot errors to address concerns about overcomplication and confusion. One way to examine this is to look at ballot exhaustion caused by errors, rather than by other methods. In considering this, we operationalize an error as a ballot that contains undervotes followed by otherwise valid rankings, and ballots with an overvote at any position. We could also consider other behavior, such as incidence of candidates ranked multiple times, however this does not always represent an error in voting. As noted earlier, some valid single-shot rankings were multiple rankings of the same candidate. This is a valid vote (albeit perhaps not an efficient vote) and not considered an error. However, we could consider candidates ranked in nonconsecutive positions to be an error. This might not invalidate a ballot, but it clearly represents a misunderstanding of the ranking process. Here we will briefly look at undervote error rates, and non-consecutive candidate rankings. A discussion of overvotes can be found in the following section on ballot exhaustion.

Undervotes followed by valid rankings

While 5,720 (4.3 percent) ballots contained an undervote followed at some point by a valid ranking, not all of these errors were consequential. Maine's rules call for a ballot to be exhausted if there are two successive undervotes. Therefore, only ballots with double undervotes and a successive valid ranking could cause a potential error. While overvotes introduce confusion due to multiple markings, we could reexamine ballots that were exhausted due to double-undervote. Interestingly, some of the public commentary given during the rulemaking process in Maine included the suggestion to eliminate exhaustion by double-undervote. However, as the state

responded, the rule had to match the law as written, which was specific about exhausting double-undervote ballots. (Maine Secretary of State 2018)

Of the 5,720 ballots with undervotes followed by a ranking, 907 had double-undervotes followed by a valid ranking. Again, this does not necessarily mean that these were all consequential errors, because some of these ballots may have contained a previous valid ranking that prevented ballot exhaustion. Of these 907 ballots, only 111 additional votes would have been added into the first round count if we ignored double-overvotes. **Table 6** shows, little is changed over the four rounds by adding those exhausted ballots to the vote count.

TABLE 6 – Additional Votes Per Round Without Double-Undervote Exhaustion

	Round			
Candidate	1	2	3	4
Cote, Adam Roland	19	25	31	60
Dion, Donna J.	4	-	-	-
Dion, Mark N.	8	-	-	-
Eves, Mark W.	10	14	-	-
Mills, Janet T.	30	44	56	107
Russell, Diane Marie	3	-	-	-
Sweet, Elizabeth A.	25	31	37	-
Write-in	9	-	-	-

Looking at the problem in a different light, we could hypothetically change Maine's rules to see how consequential these undervote errors are by exhausting all ballots with a single undervote, rather than a double-undervote. Under this procedure, 405 additional ballots would have been excluded by the final round. This gives us an idea of a worst-case scenario.

Multiple non-consecutive rankings

Another error we could consider is the ranking of a candidate in multiple non-consecutive positions. This is another one of Alvarez et al.'s inconsistent ballot types. A total of 2,654 (2

percent) of all ballots contained multiple non-consecutive rankings for one candidate. This represents nearly three to four times the rate found in the Alvarez study. To be sure, we might expect the rate to be higher with a larger number of ranking positions available to Mainers (only three rankings were allowed in the previous study), however this might be an opportunity to dive deeper into the Maine case to examine more fully these ballot errors and if they were consequential. In total, looking at multiple consecutive and non-consecutive rankings of the same candidate, 3.3 percent of ballots, or 4,365 ballots ranked a candidate more than once. This overall rate was much lower than what was reported in Burnett and Kogan's 2015 study of California RCV elections.

Ballot Exhaustion

Ballot exhaustion occurs in RCV systems for a number of different reasons. Maine's official election returns report three types of exhaustion - undervote, overvote, and exhausted choices. It is common to examine the residual vote reported from state returns (commonly overvotes combined with undervotes, as states do not commonly report distinct statistics, and because no other state would have ballots exhausted from exhausted choices) in order to assess of the performance of election technology (Ansolabehere and Stewart, 2005; Hammer et al., 2010; Kimball and Anthony 2016) .

Looking at overall rates and comparing them to the Ansolabehere and Stewart study, we can see that the final-round Maine residual rate of 11.3 percent is many times higher than what we would expect from an optical scan system. Ansolabehere and Stewart reported average residual rates of 1.6 to 3.0 percent for optically scanned paper ballots. What is the source, then, of this discrepancy, and does the high residual rate of Maine's RCV system warrant concern? A better measure of Maine's residual rate should remove ballot exhaustion in later rounds and focus

instead on first round residual vote in order to be comparable to non-RCV elections. Correcting this measurement, we find a 4.6 percent residual vote rate, which, while still troublingly high compared to other research. In order to uncover what drove this high rate, it would be worthwhile to examine these votes in more detail.

Exhaustion by undervote

In total, 14,155 ballots were exhausted by undervote before the final round of counting. This accounts for 10.7% of the total votes cast. This number, however, can be a misleading indication of the poor performance of RCV. First, a final-round residual rate is an RCV system is not directly comparable to a single-round residual rate. Examining the first round residual vote, we see 5,681 ballots were exhausted by undervote. This means that a voter abstained in the selection of a first *and* second choice. Maine's rules allow for a single undervote to be skipped, meaning an undervote followed by a valid ranking would be counted, rather than exhausted. In most cases, exhaustion by undervote in the first round of counting indicates a blank ballot. Indeed, 5,535 (4.2 percent of total) of the 5,681 exhausted ballots were completely blank. However, 146 ballots contained some markings after the first two undervotes that might have constituted an otherwise valid ranking. This number is significant, because this is precisely the type of undervoting error that is a valid indicator of election performance. Examining these 146 ballots, 108 contained an otherwise valid ranking after the double-undervote, 31 did not contain a valid ranking, and the remaining seven contained a ranking, but only after a disqualifying overvote.

Returning to an examination of the 5,535 completely blank ballots, we identified 2,673 voters who were also eligible to vote in Maine's congressional primary. Of these voters, 2,292 also cast a completely blank ballot in the congressional primary and the remaining 371 voters cast a valid vote. While we cannot be sure that all of the 5,535 blank ballots are voluntary abstentions (and

therefore not necessarily a valid indicator of election performance in a tabulation of residual vote) it is clear that some are, as these individuals opted out of the gubernatorial race and still voted in the congressional primary. Of the remaining congressional primary ballots, eight were exhausted due to undervote but contained a valid ranking, and two were exhausted due to an overvote, and did not contain a valid ranking in any position. Without ballot images for the remaining non-ranked choices it is impossible to tell whether or not the 4.2% of voters who left their ranked votes blank also left non-ranked choices blank. However, this rate is at the low end of the range of abstention rates reported by Avarez et al. (2018) in their study of the structure of rankings in the 2008 Pierce County (Washington) elections. This is also lower than the 14% of ballots left blank in Maine's 2014 Democratic gubernatorial primary and 18% in that year's Republican gubernatorial primary.

Exhaustion by overvote

A second type of exhaustion reported by the state is exhaustion by overvote. Official election results reported 580 ballots exhausted by overvote. An overvote is an instance when a voter ranks more than one candidate for a single ranking position. We do not have information on which candidates are marked, but we know the position in which the overvote took place. Looking closer at overvotes more generally, we find that 1,843 (1.4%) ballots contained overvotes at some position on the ballot. In 1,263 (0.95%) ballots, the overvote occurred after a valid ranking, which leaves the 580 (0.4%) remaining exhausted ballots that the state reported. This rate of overvoting is similar to that reported by previous research on overvote rates in San Francisco (Neely and Cook, 2008; Neely and McDaniel, 2015).

Returning to the 580 ballots exhausted by overvote, we find 425 of these ballots contained overvotes in the first ranking position, exhausting them immediately. Five further ballots

contained an undervote in the first position and an overvote in the second position, for a total of 430 ballots exhausted by overvote in the first round. As previously mentioned, in this case of one undervote, the next ranking is used without exhausting the ballot, therefore exhaustion was caused by the overvote in the second ranking. If there were more than two undervotes before an overvote in the third ranking, the ballot would be exhausted by the double-undervote rather than the successive overvote. Examining the 430 overvotes that contained no previous valid ranking, 248 contained otherwise valid rankings at later positions, whereas 167 contained an overvote in the first position and undervotes in all other remaining positions. A further 14 ballots contained a mixture of only overvotes and undervotes, and one single ballot contained an overvote at every ranking position. Adding these overvote ballots into the results would not have changed the outcome of the election (although it is impossible to know the true intent of overvotes, these few ballots would not have changed any elimination of a candidate).

Exhaustion by candidate exhaustion

A third type of exhaustion reported is candidate exhaustion. This means that while there may be more ranked candidates on a ballot, those candidates have all been eliminated. This exhausts the ballot because choices are exhausted, not because of a lack of or excess of rankings at a given position. Definitionally, there can not be a ballot exhausted by candidate elimination in the first round, as none of the candidates have been eliminated yet. Rates for other rounds are low, with only 265 ballots exhausted by exhausted choices. This is a relatively rare occurrence because it requires a completely ranked ballot wherein all ranked candidates are eliminated. Any other ballot would either count for a continuing candidate or be eliminated by undervote. To demonstrate this, single-shot votes for eliminated candidates of the form (2UUUUUUU) are

exhausted by undervote, whereas ballots of the form (22222222) would be exhausted by exhausted choices. As noted earlier, relatively few ballots were completed in this manner.

Discussion and Conclusion

What can be made from this analysis of Maine's 2018 gubernatorial primary? Broadly speaking, the election does not seem to be out of the ordinary compared to analyses of other RCV elections, and scholars will likely find its inclusion in studies to bolster their arguments.

Summarizing descriptive findings, we can paint a picture of Maine's first foray into RCV. First, evaluating voting propensities, we can see that the vast majority of Mainers (88 percent) chose to rank order some number of candidates in the 2018 gubernatorial primary. Among these, a plurality completed their ballot, ranking the entire field. Second, while we identified a number of balloting errors, we found that including undervote errors into the election would have had no significant effect. Moreover, rates of overvoting were in line with other analyses, and that only a fraction of these overvotes had an impact on the counting of a ballot.

One item of particular note that invites additional study is the rate of completely blank ballots. In Maine's second RCV election (the 2018 general election) this rate was nearly half. Examining the differences between this first and second election could shed light on who abstained, contributing to the discussion on potential RCV confusion.

Addressing the question of confusion versus voluntary abstention could also contribute to another academic debate. Recent work has pointed out the fact that RCV does not necessarily yield majority winners (Burnett and Kogan 2015). This work examined a number of races, comparing the winner's final vote count to the total number of ballots cast. In all cases, the winner did not attain a majority of all ballots cast. The reason for this is the number of exhausted

ballots. However, having looked into ballot exhaustion more completely, perhaps we need to assess the utility of *all ballots cast* as a metric. As noted earlier, a full 1/3 of all exhausted ballots were completely left blank. If these abstentions are due to the confusing nature of RCV, then they rightfully should be included in calculating some measure of all ballots. However, should these ballots be included in a count of *all ballots cast* if they are voluntary abstentions? This question will continue to cause consternation in the debate over RCV, and scholars should look to Maine to continue to refine their arguments. If entirely blank ballots were removed in the Maine case, the winning candidate would have received 50.02% of *all ballots marked.* To be sure, this is the barest of majorities, but it does highlight how important blank ballots are to this discussion.

Maine's first effort with RCV seems to have been a success when benchmarked against other RCV elections in the United States using this method. Rates of single-shot voting seem to be less than reported in other studies, however, the number of abstentions is still concerning and deserves additional study. There were also an unsettling number of errors on ballots, however, the effects of these errors seem to have been limited in this case. In sum, Maine's first ranked-choice election has provided scholars with a wealth of information that should continue to be added to our investigation into RCV and will hopefully refine and enhance our discussion of this voting system.

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