New Yorkers for Verified Voting

Estimating the Number of Voting Machines for New York State's Polling Places

William A. Edelstein, Ph.D.
Board of Directors, New Yorkers for Verified Voting
w.edelstein@gmail.com
January 30, 2007

As New York implements the Help America Vote Act, it is imperative that there be enough voting machines to cope with fluctuations in voter arrival times, machine breakdowns, ballot complexity, and variations among polling places. The "Voter System User Rate Assessment Study" carried out by AIR (American Institute of Research)[1] unfortunately does not address the critical question: How many voters can use each voting machine in one day? This is because the AIR study leaves out many important factors, most notably, the effect of uneven voter arrival and concentration of voters during peak periods of the Election Day. Also, its assessment of the needs of voters with disabilities is inadequate.

Taking into account the AIR figures for the time needed to vote on a DRE or mark a paper ballot in a PBOS system (paper ballot/optical scan) along with other data, and applying our own analysis[2] of the effects of variable voter arrival times and Election Day busy periods, we have produced guidelines for voting machine numbers.

Our Recommendations

DREs	1 DRE per 200 non-disabled registered voters. 1 additional DRE per 60 registered voters who want to use accessibility features.
PBOS	1 marking booth per 200 non-disabled registered voters. 1 scanner per 4,000 registered voters 1 ballot marking device (BMD) per polling place. In a large precinct, 1 BMD per 60 registered voters who want to use accessibility features.

Our DRE figures are similar to the requirement in Ohio for one DRE per 175 registered voters[3] that is scheduled to be in place by 2013.

They are also consistent with the experience of a voting precinct in Nashville, TN with two DREs. This arrangement worked well in the 2006 primary with 214 total voters (107 per DRE) but had very long lines in the 2006 general election with 527 voters (263 per DRE).[4]

The figures for PBOS are consonant with a New Hampshire requirement for a maximum 125 actual voters per marking booth[5] and 91 actual voters per marking booth in Lee, MA.[6] Both New Hampshire and Massachusetts have 13-hour Election Days compared to New York's 15-hour Election Day.

Londonderry, NH accommodated 6,000 actual voters in 2004 with a single scanner and no lines.[4] We suggest that—with undervote notification turned on in New York—one scanner per 3,000 actual voters, or one scanner per 4,000 registered voters, will be sufficient here.

Since DREs cost more than $8,000 each and marking booths less than $200, the acquisition cost for DRE systems will be much greater than that for PBOS, where a single $6,000 scanner can serve many marking booths. In addition, the costs for software purchases, annual license fees, and maintenance are substantial and will be greater with DREs, since many more DREs will be required.

Underestimating the number of DREs would be far more problematic than miscalculating the required number of marking booths. On Election Day, it would not be possible to quickly get more DREs. However, it would be feasible to use simple cardboard screens on tables for voter privacy instead of marking booths. Londonderry, NH has a supply of these to accommodate an unexpected surge of voters with their PBOS system.[5]

We finally note that AIR did not ascertain how many voters might want to use accessibility features. This number is critical for determining how many voting machines will be purchased for that purpose, and remains to be estimated or researched.

Our Calculations

We begin with a figure of 3 minutes for a non-disabled voter to vote on a DRE or mark a paper ballot in a PBOS system. We use a possible maximum voter turnout[2] of 75%. "MDR" as defined by AIR[1] is the "maximum daily rate" of people that could use a machine if (in this example) everybody came at exact 3 minute intervals and took exactly 3 minutes to vote.

Non-disabled voters

MDR: 900 minutes per day /3 minutes to vote = 300 voters per machine or marking booth

Adjust for peak voting times: 300 voters/2 = 150 actual voters per machine or marking booth

Registered voters: 150 actual voters/75% max turnout = 200 registered non-disabled voters per machine or marking booth

Voters using accessibility features

MDR: 900 minutes per day /10 minutes to vote = 90 voters per DRE or ballot marking machine

Adjust for peak voting times: 90 voters/2 = 45 actual voters per DRE or ballot marking machine

Registered voters: 45 actual voters/75% max turnout = 60 registered voters per DRE or ballot marking machine using accessibility features

Scanners

Londonderry, New Hampshire: 6,000 actual voters per scanner in a 13-hour election day, no lines[5]

New York: Turn on undervote notification: 6,000/2 = 3,000 actual voters per scanner in a 15-hour election day

New York registered voters: 3,000 actual voters/75% = 4,000 registered voters per scanner in a 15-hour election day

Why our conclusions about the number of DREs differ from the AIR study

- The AIR study measures the time spent on each voting machine. It then divides this time into the total Election Day (900 minutes) and determines what it calls the MDR (maximum daily rate). The MDR is, however, a large overestimate of the number of voters that can actually use any voting machine without creating long lines.[2]
- The cycle time for voters is the total time between voters and therefore must include the times before and after voting when the voter approaches or leaves the voting booth, and the next voter recognizes that it is time to go from the line to the booth. This must add at least 1/4 minute (15 seconds) to the times determined by AIR.
- The AIR report does not explain when or how participants were instructed to check the VVPAT. A number of participants in these studies have told us that the VVPAT was not mentioned when they received instructions. The AIR report itself suggests that the Liberty VVPAT, in particular, is so obscure that the Liberty voting time was artificially shortened (ref 1, page 38). If someone really

wants to check their votes on the Liberty machine, therefore, it would be necessary to allow at least an additional 30 seconds to check that machine's VVPAT.

- There is a wide variation of voting times in the AIR study ranging from just under 3 minutes to over 5 minutes. The total voter cycle time (as explained above) would be slightly longer. All figures had large standard deviations. For the purpose of our calculation we assume—somewhat optimistically—that, with experience, the average voting time for non-disabled voters on a DRE or paper ballot could come down to 3 minutes.
- The AIR report does not take peak voting times into account. A good estimate of the number of voters using each machine in an Election Day, based on our study of peak voting and queuing effects,[2] can be determined as follows. Divide the voting cycle time into the total Election Day minutes, and then divide that number by 2. In this way, according to our calculations, the length of queues should be minimized.
- Regarding voters with disabilities, the AIR report is vague. On page 39 they say that these "MDR estimates [for voters using disability aids] may be misleading" because they don't know if their sample is representative. In fact, they don't have any data on any correlation between the nature of the disability and the voting time. Given that some of the times for voting using accessibility features measured by AIR were on the order of 10 minutes, and some of the times measured by the SBOE were over 30 minutes,[7] we estimate 10 minutes per voter using accessibility aids.

Why our conclusions about paper ballots/optical scan differ from the AIR study

- Paper ballot-optical scan (PBOS) systems are generally used with many marking booths and a few scanners. In some of its results AIR combined the time in the marking booth with scanning time; this is irrelevant. The real questions are: how much time to mark the ballot and how much time to scan?
- In the AIR study, the scanner attendant went through an unnecessarily long statement before the ballot was accepted. Also, not all ballots will be undervoted in real elections. Thus this test process inflated the time to scan.

References

1. DG Norris and CA Paulson, *American Institutes for Research*, "New York State Voter System User Rate Assessment Study", 12/11/2006, 2006. http://www.elections.state.ny.us/NYSBOE/hava/DRAFTAIRSTUDY.pdf.
2. WA Edelstein, *New Yorkers for Verified Voting*, "New Voting Systems for New York--Long Lines and High Cost," 2006, http://www.nyvv.org/doc/voterlines.pdf.
3. M Riess, T Wang, R Randhava, B Burt, M Schaffer, and ST Steigleder, *The Century Foundation*, "Voting in 2006: Have We Solved the Problems of 2004?" 10/2006. http://www.tcf.org/list.asp?type=PB&pubid=584.
4. B Schrade, A Paine, R Loos, and LA O'Neal, *The Tennessean*, "Metro wants more voting machines," 2006, http://www.tennessean.com/apps/pbcs.dll/article?AID=/20061109/NEWS0206/611090388/1001/NEWS.
5. M Seymour, *Subject:* 2004 PBOS Voting in Londonderry, NH. *Personal communication to* W. Edelstein, 10/2006.
6. R Millman, "Do the Math," 2006, http://www.nyvv.org/wmv/Do-The-Math-128kps.wmv.
7. AE Svizzero, *New York State Board of Elections*, "Authorization Testing for HAVA Plan B Ballot Marking Devices", 5/20/06, 2006. http://www.elections.state.ny.us/NYSBOE/hava/VendorAuthorization.pdf.