



Mitigating Election Line Lengths Using Sagata® VotePro

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Executive Summary

This article describes the common phenomenon in which most voters experience negligible lines while a small percentage wait for several hours. The line lengths can become very long or “explode” *both* because of random happenstance at individual polling locations (e.g., strings of arrivals combined with slower than average voters) *and* because of the sheer number of polling locations. An approach is proposed for mitigating waiting problems using Sagata® consulting and software to determine how many direct recording equipment (DRE) machines and/or booths are needed and where to put them.

Keywords: queuing, discrete event simulation, direct recording equipment (DRE)

1. Introduction

All of us realize that lines in elections vary unpredictably. Further, when most of us first think about election lines we imagine waiting ten minutes plus or minus five minutes. Yet, actual election experience both real and simulated is much different. In relation to the 2004 presidential election in Franklin County Ohio, consider the experience of voters arriving at 7:30 pm. Over half of these voters would have waited less than 1 hour. At the same time, over 11% would wait greater than 3 hours. Also, it is easy to simulate elections in which the average waiting time is less than 3 minutes but the average person in a few precincts wait over 3 hours. Random variation can cause long lines at locations that can be difficult to predict before elections.

We have modeled waiting lines and studied past elections (Allen and Bernshteyn, 2006a and b). We have shown that ballot length variability explained why certain precincts were much more likely to have long lines in Franklin County in 2004 than others (Allen and Bernshteyn 2006a). In that paper, we showed how elementary formulas are sufficient to explain the variation observed. Therefore, the simple phenomenon of unusually frequent arrivals and slow voting times is enough to explain long lines. By voting times, we mean the time required in front of the direct recording equipment (DRE) after the voter leaves the line and reaches the machine (*Figure 1*).

Despite the challenge of unpredictable waiting times, careful allocation of machines can greatly reduce the chance of long waits. In realistic cases, reductions to effectively minimal waits can be achieved with surprisingly small additional expenses (if any). For example, in Allen and Bernshteyn (2006b), we showed how under pessimistic scenarios, waiting times can be effectively be eliminated using only roughly 20% more machines. The purpose of this document is to promote our consulting service and Sagata® VotePro software.

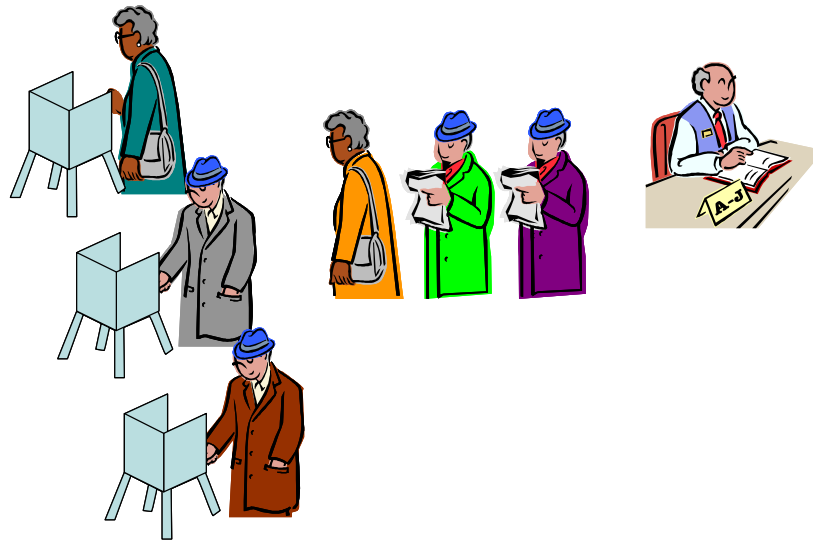


Figure 1. Depiction of voters leaving the registration desk, queuing, and voting.

2. Principled Apportionment and Allocation of Direct Recording Equipment

Sagata® consulting services and VotePro software are designed to address two questions: How many direct recording equipment (DRE) machines a county should have on hand? And how the machines should be allocated to polling locations? Related issues are depicted roughly in *Figure 2*. Historically, apportionment and allocation are performed using the judgment of officials familiar with voting in the particular locality. However, such experience-based approaches have at least three major drawbacks:

1. Voter attendance can reach unprecedented levels on a continuing basis leading to potentially very long lines.
2. Without a principle-driven algorithmic approach, citizens critical of the process might feel that arbitrary judgment was applied to disenfranchise a specific group.
3. Conceivably, more machines than needed might be apportioned wasting millions of dollars.

Our service and software use proven methods to minimize apportionment and allocations problems. Furthermore, the recommendations derived achieve maximum “defensibility” because they can be traced back to documented assumptions and a transparent algorithm. We simply apply the most realistic simulation model we can imagine and evaluate the average waiting times at all locations during elections. All details of this model including machine out-of-service conditions are specified in Allen and Bernshteyn (2006b). Then, we add or remove machines until all simulated voters achieve waits that are acceptable even under reasonably conservative assumptions.

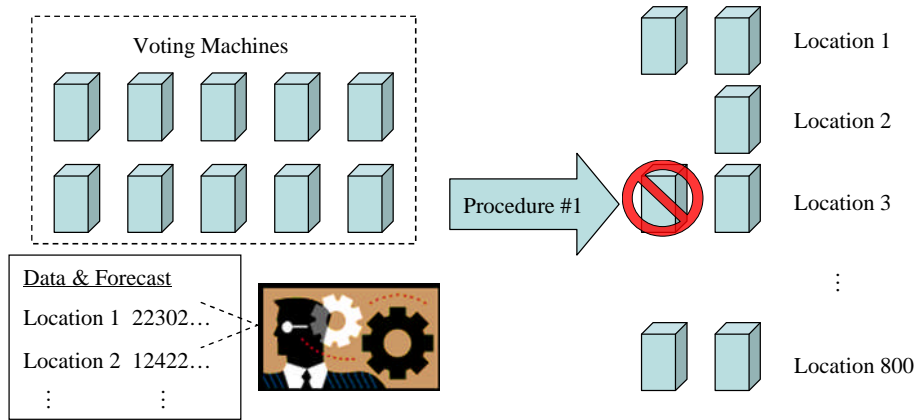


Figure 2. Allocation process including forecasting and allowance for machine downtime.

3. Software and Consulting Inputs

When the Sagata® team engages with a voting related client, we elicit data about what type of turnout might occur, how long the ballots are (measured in average times required in front of DREs), and how reliable the voting equipment are. Those and other inputs are sketched in Figure 3 part a; the outputs from our program are sketched in part b. Because the outputs of the Sagata® software are derived using advanced statistical methods, we insist that our trained staff evaluate and certify outputs personally. Working together, we can develop sensible and defensible apportionment and allocation.

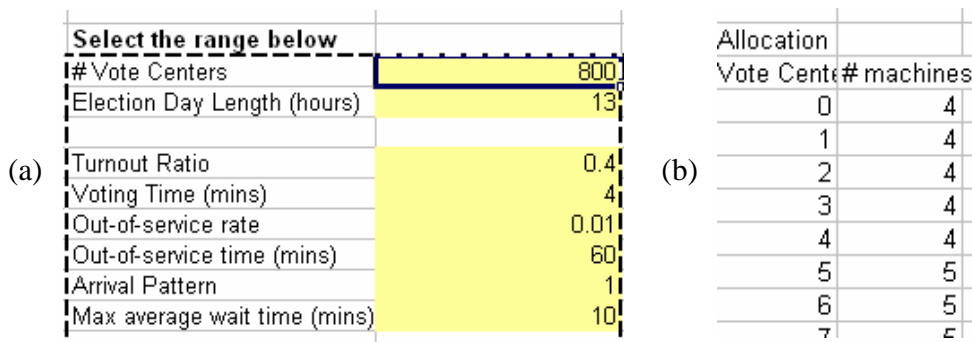


Figure 3. Screenshots of inputs and outputs of the Sagata® VotePro software.

Acknowledgments

We thank Steven Hertzberg of the Election Science Institute for commissioning much of our work on elections and officials at Franklin and Cuyahoga counties in Ohio.

References

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