A Model for Increasing Voter Turnout through the Optimal Placement of Polling Precincts

By Aven-Leigh Schnarr
Advisor: Dr. Neil Simonetti & Caira Bongers

"With privilege comes responsibility. Those of us who are privileged to live in a free society have a responsibility to participate in the political process whereby that freedom is preserved" (Orthwein 342)

ABSTRACT

Scholarly research has found that there is evidence to support the conclusions that distance to polling locations can affect whether or not eligible individuals vote in an election (Haspel 561; McNulty 435; Brady 1) and that voter behavior can be modeled using the rational choice theory (Riker 38).

During the research two conclusions were used to create a model to increase voter turnout through the optimal placement of potential voters' polling locations.

Using the assumption that the relationship between how far a potential voter lives from their designated polling place and their likelihood of voting is linear, this research created a linear model of this problem.

Model Explanation

The model is designed to determine which of the given potential polling places should be used. The model assumes a city grid as the region being optimized and assumes that all the potential voters who live on the same block live the same distance away from a particular potential polling location.

When the model was formulated into a computer program for a randomly generated data set for a twenty-by-twenty grid of city blocks, it provided an optimal solution.

Linear Model

$$Maximize: \sum_{i=1}^{b}\sum_{j=1}^{n} P_i T_{ij} A_{ij}$$

$Subject\ to:$

$$\sum_{i=1}^{n} p_i \leq X$$

$$\sum_{j=1}^{n} A_{ij} = 1, for\ all\ i \in B$$

$$\sum_{i=1}^{b} P_i A_{ij} \leq c_j\ for\ all\ j \in N$$

$$A_{ij} \leq p_j\ for\ j \in N$$

$$A_{ij} \in \{0,1\}\ and\ p_j \in \{0,1\}$$

This model is designed in the fashion of the linear programs discussed in *Linear Models and Methods of Optimization* taught by Dr. Neil Simonetti at Bryn Athyn College.

Variable Explanation

A_{ij} is a binary variable that represents the people from some block *i* being assigned to vote at some polling place *j*. A_{ij} takes on the value of 0 when the people from block *i* are not assigned to polling place *j*. A_{ij} is equal to 1 when the people of block *i* are assigned to polling place *j*.

n is the maximum number of potential polling places to be used as polling places.

$N = \{1,2,3,4,\ldots\ldots\ldots,n\}$

b is the total number of blocks in the data set.

$B = \{1,2,3,4,\ldots\ldots\ldots\ldots,b\}$

X = the maximum number of polling places

c_i = the capacity of a polling place *i* for all $i \in N$

$P_i =$ the population for a block *i* for all $i \in B$

$T_{ij} = -(10M * 0.0025) + S$, where *S* is the percentage of eligible voters who vote when the distance to a given polling place is zero, *M* is the distance, in miles, between polling place *j* and potential voters who reside on block *i*. The 0.0025 is the decrease in voter turnout for every tenth of a mile a potential voter lives from the polling place (Brady; McNulty).

Visualization of Optimally Placed Polling Precincts

0	x	0	0	x	0	0	0	0	x	14	19	47	22	20	45	6	50	1	43
24	9	43	2	28	30	43	52	5	17	30	13	26	51	44	44	59	60	8	30
35	34	29	6	33	57	59	29	11	28	40	9	39	28	22	14	31	19	32	43
50	53	23	0	47	51	18	27	32	47	15	56	23	13	26	49	5	20	6	53
29	32	32	2	45	2	37	50	23	14	37	22	37	56	39	57	19	21	24	22
57	6	56	22	53	9	23	17	30	14	x	9	40	28	36	11	30	54	31	52
57	34	43	33	13	58	13	40	25	9	17	57	32	59	43	48	48	13	50	30
15	2	27	8	14	36	6	0	27	21	21	44	57	40	10	47	30	43	51	33
3	18	28	0	46	50	9	41	40	42	6	17	36	19	28	28	40	4	34	46
34	7	15	2	40	30	15	44	4	51	48	x	x	17	24	57	59	35	52	46
45	10	46	46	11	54	33	44	7	44	38	14	47	3	41	24	28	36	49	18
26	41	31	52	18	39	13	39	12	17	50	0	39	56	7	42	50	23	47	33
4	40	60	22	14	40	17	51	1	40	52	35	5	0	x	11	8	18	31	38
26	51	17	12	36	3	49	51	44	7	5	35	29	15	40	10	45	9	8	27
47	56	52	20	20	58	1	23	15	13	48	1	19	4	0	23	31	49	23	33
17	14	44	15	37	18	35	39	60	4	37	38	50	30	18	0	60	17	29	33
45	40	6	44	4	43	0	11	44	14	44	27	53	1	34	8	x	19	6	54
0	x	x	20	5	46	39	30	56	9	17	51	35	46	29	48	51	60	15	33
51	41	48	0	0	x	0	0	x	0	x	0	0	x	26	32	56	9	32	36
0	0	0	7	21	11	47	9	10	16	53	11	6	3	33	29	50	19	55	28

The dark blue squares represent the optimally chosen polling places and the light blue squares represents the unselected potential polling locations

Conclusion

Voting is essential to democracies. It is one of the founding principles of this form of governance and it is important that elections are made to be free and fair for the health of any democracy. The objective of making elections accessible to all should be at the forefront of election officials minds and using a model that works to minimize the distance required to travel to a polling place could help them better achieve this objective. While this is not a perfect solution, and should be used with care, it is a practical and feasible solution that could help to make democracies better.

References

Brady, Henry E, and John E. McNulty. "The Costs of Voting: Evidence from a Natural Experiment." *Www.researchgate.net*, 21 Aug. 2015, www.researchgate.net/publication/247821641_The_Costs_of_Voting_Evidence_from_a_Natural_Experiment. Accessed 20 Oct. 2020.

Dyck, Joshua J., and James G. Gimpel. "Distance, Turnout, and the Convenience of Voting." *Social Science Quarterly*, vol. 86, no. 3, 2005, pp. 531–548. *JSTOR*, www.jstor.org/stable/42956079. Accessed 20 Oct. 2020.

Haspel, Moshe, and H. Gibbs Knotts. "Location, Location, Location: Precinct Placement and the Costs of Voting." *The Journal of Politics*, vol. 67, no. 2, 2005, pp. 560–573. *JSTOR*, www.jstor.org/stable/10.1111/j.1468-2508.2005.00329.x. Accessed 29 Apr. 2020.

McNulty, John E., et al. "Driving Saints to Sin: How Increasing the Difficulty of Voting Dissuades Even the Most Motivated Voters." *Political Analysis*, vol. 17, no. 4, 2009, pp. 435–455. *JSTOR*, www.jstor.org/stable/25791987. Accessed 20 Oct. 2020.

Orthwein, Walter E. "Why we have a Duty to take an Interest in Politics." New Church Life 2004: 342-345. Heavenlydoctrines.org. Web. Accessed 22 Oct. 2020.

Riker, William H., and Peter C. Ordeshook. "A Theory of the Calculus of Voting." *The American Political Science Review*, vol. 62, no. 1, 1968, pp. 25–42. JSTOR, www.jstor.org/stable/1953324. Accessed 2 Feb. 2021.