1163-AF-304 **Alan Krinik*** (ackrinik@cpp.edu), **Jeremy J Lin**, **Thuy Vu Dieu Lu**, **Mark Dela**, **David Perez**, **David Beecher** and **Weizhong Wong**. *Generalized Ballot Box Problem Using Linear Algebra.*

Suppose that in an election between two candidates A and B that A wins by k votes. The classical ballot box problem asks what is the probability that candidate A is never behind candidate B during the counting of n ballots. If we assume that each voter cast a vote for either A or B with probability 1/2, then there is an elegant, well-known, combinatorial solution to this problem.

We generalize this ballot box problem by assuming that the probabilities of voting for A or B correspond to one-step transition probabilities of certain birth-death chains. This allows for non-uniform (or varying) probabilities and also allows for the probability of abstention from voting. Under these circumstances, we present a method to solve this generalized ballot box problem in terms of powers of certain matrices.

This linear algebraic approach leads to studying formulas, that scale up, for powers of certain types of nxn tridiagonal matrices in terms of their known eigenvalues. This work also produces explicit expressions for the transient probabilities of various finite birth-death chains or processes. (Received September 01, 2020)