The Moderating Effect of Instant Runoff Voting

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Background

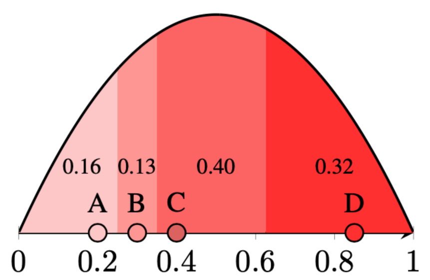
Does IRV elect more moderates than plurality?

Plurality
voters vote for their favorite; most votes wins

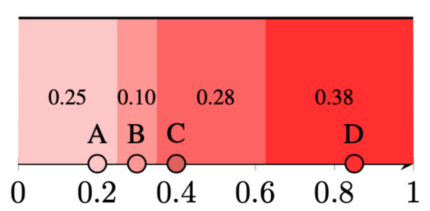
IRV
voters rank all candidates; repeatedly eliminate candidate with fewest first-place votes, last left wins

1-Euclidean preferences
voters and candidates in [0, 1], voters rank candidates by distance

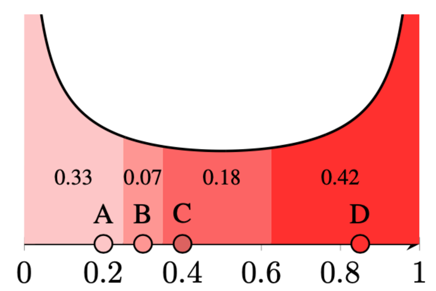
Moderate, extreme
close to 1/2, close to 0 or 1



Moderate voters
IRV C, *plurality* C



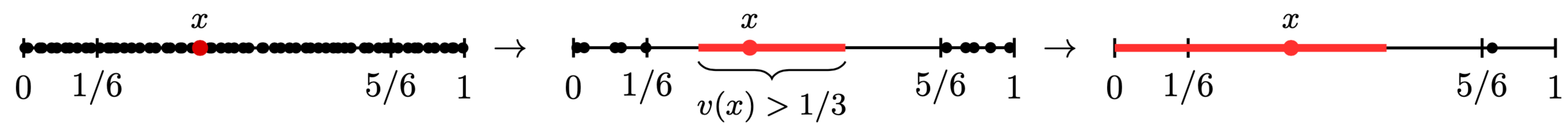
Uniform voters
IRV C, *plurality* D



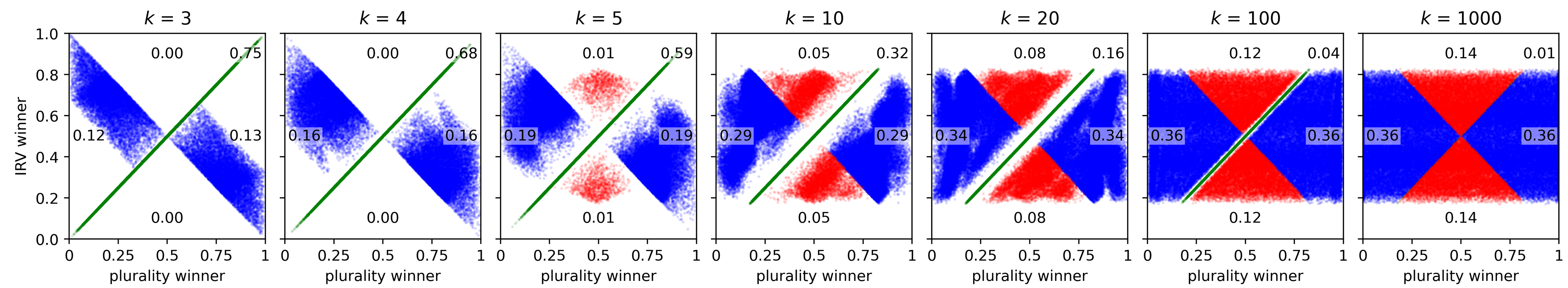
Polarized voters
IRV A, *plurality* D

Overview

We prove that IRV prevents extreme candidates from winning, but plurality does not.



Uniform voters and k candidates, 100k elections; blue: IRV more moderate, red: plurality more moderate, green: same winner



Results

Definitions

Voter distribution CDF F, PDF f
Candidate count k

Exclusion zone
Interval $I \subset [0,1]$ such that the winner must be in I (if at least one candidate is in I)

Combinatorial moderating effect
if I is an exclusion zone for all k

implies

Probabilistic moderating effect
if $\Pr(\text{winner is in } I) \to 1$ as $k \to \infty$ when we draw candidates from F

Uniform voters

Theorem 1. [1/6, 5/6] is an exclusion zone of IRV for all k, and the smallest one for all $k \geq 3$.

Theorem 2. No combinatorial moderation for plurality (i.e., no exclusion zones).

Theorem 3. No probabilistic moderation for plurality; winner distribution → uniform as $k \to \infty$.

Propositions 1 & 2. Exact winner distributions for plurality and IRV with uniform voters and candidates for $k = 3$. (Cross-sectional area of winner polytopes, piecewise quadratic.)

Non-uniform voters

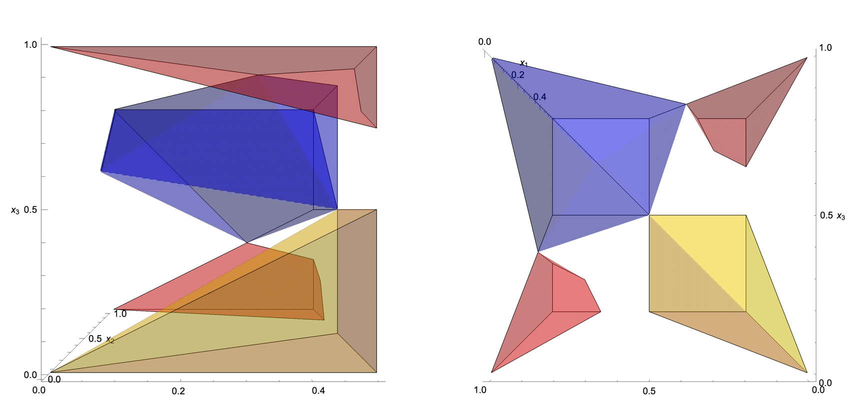
Theorem 4. Symmetric voters with CDF F. $[c, 1-c]$ is an exclusion zone of IRV if for all $x \in [c, 1/2]$, $F([x+1-c]/2) - F([x+c]/2) > 1/3$.

	Voters	IRV exclusion zone
Theorem 5.	*Moderate* (f inc. on [0, 1/2])	$[F^{-1}(1/6), F^{-1}(5/6)]$
Theorem 6.	*Polarized* (f dec. on [0, 1/2], $F(1/4) < 1/3$)	$[F^{-1}(1/3) - 1/4, 5/4 - F^{-1}(1/3)]$
Theorem 7.	*Hyper-polarized* (f dec. on [0, 1/2], $F(1/4) > 1/3$)	$[0, 2F^{-1}(1/3)] \cup [1 - 2F^{-1}(1/3), 1]$

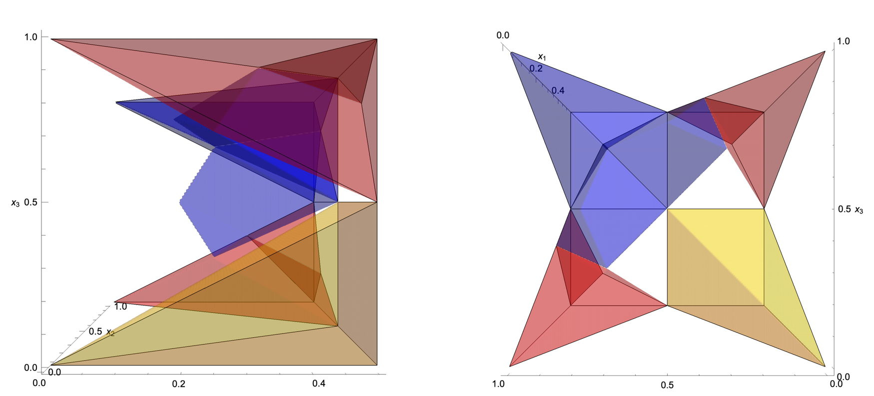
Theorem 8. No combinatorial moderation for plurality for any F.

Simulations

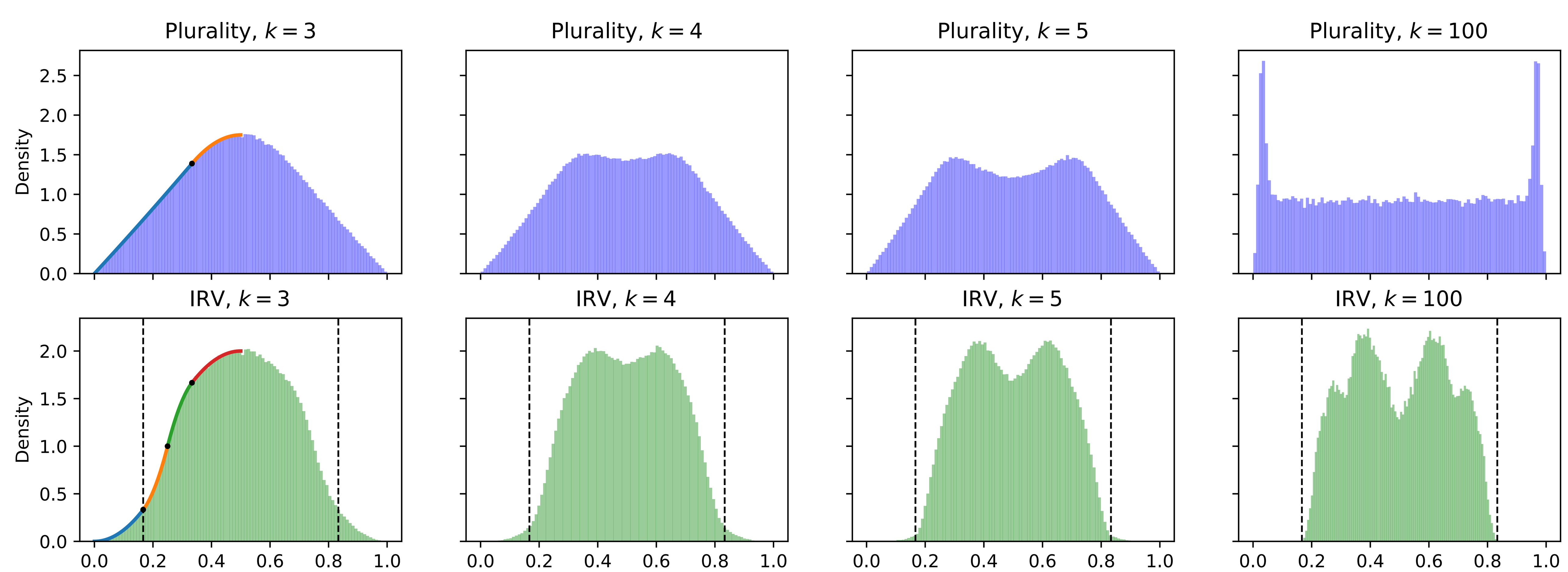
Plurality winner polytopes, k = 3



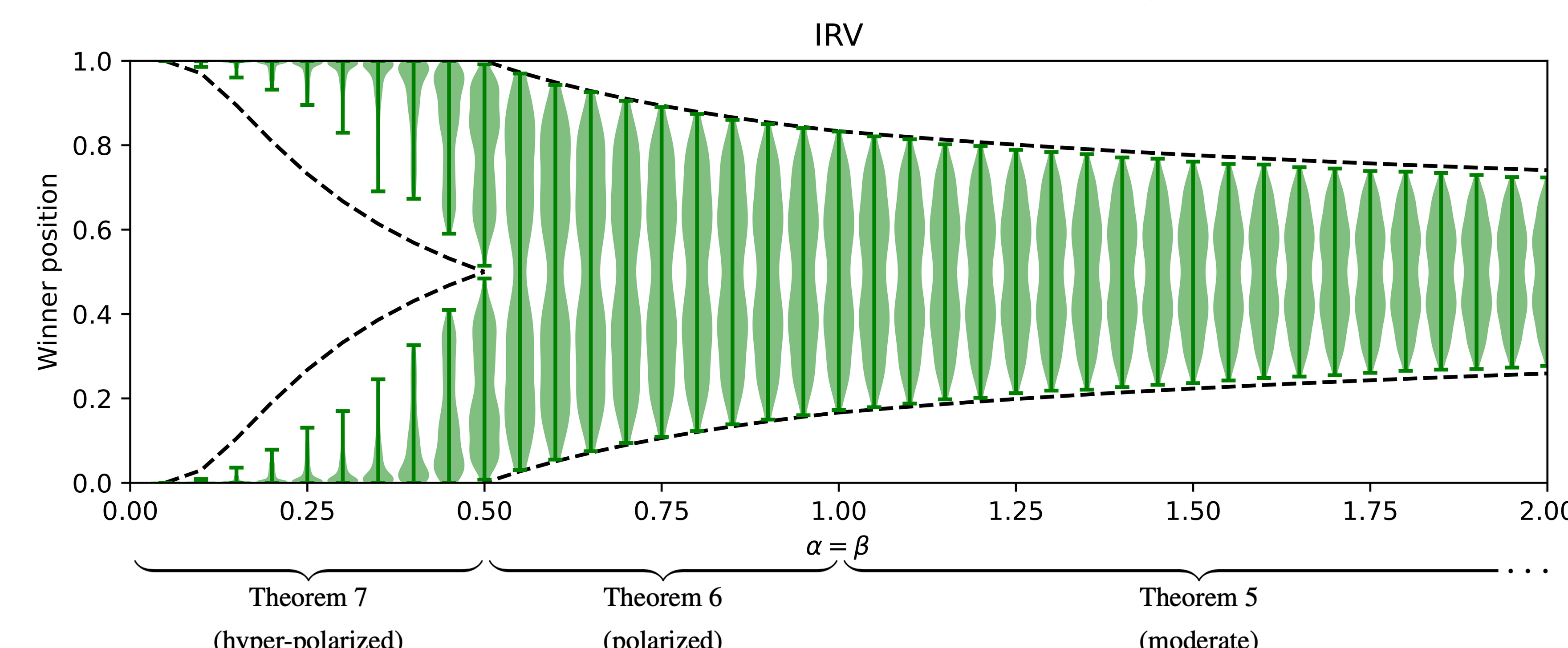
IRV winner polytopes, k = 3

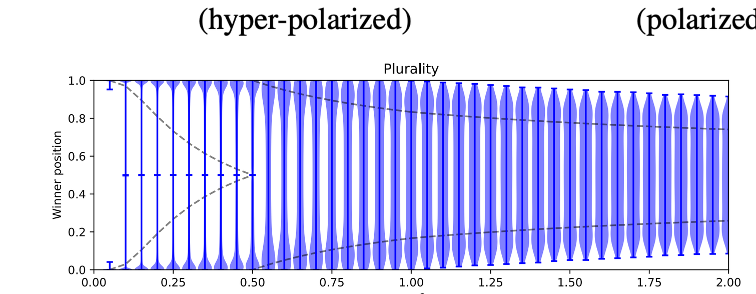


Uniform voters and candidates, 1m elections



Beta-distributed voters and 30 candidates, 100k elections





Full paper

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