Game Theory and Voter Turnout

By

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Motivation

- Election Turnout Prediction
- Understand people’s motivations
- How to encourage people to turn up to vote
- Indian Election – April to may – 900 Million eligible voters
- Create scalable models for such numbers

Economic Theory of Political Action in a Democracy - Anthony Downs (1957)

- Assumption:
  - Universal Suffrage
  - Two or more Parties
  - Voters’ utilities are a function of govt. action
  - Govt.’s policies are a function of popular desires and opposition policies
  - Opposition Party’s policies are a function of govt’s policies and people’s utility income from incumbent’s actions
  - Parties’ sole purpose is to get elected

Economic Theory of Political Action in a Democracy (contd..)

- Two scenarios:
  - Perfect Information
  - Imperfect Information
- Perfect Knowledge:
  - Voters know the govt.'s and opposition's policy function
  - Govt. and Opposition know voters' utility functions
- Imperfect Knowledge
  - Different entities have varying amounts of information
  - Voters might not know about all actions taken by the govt.
  - Voters might not know the govt.'s and opposition's policy function

Economic Theory of Political Action in a Democracy (contd..)

- Imperfect Knowledge
  - Some individuals will have more information than others
  - Individuals with less information can be swayed by those who have more information
  - Information is costly (time)
  - Voters are rational => Information is gathered only if Marginal expected utility of additional unit of information is greater than the Marginal expected cost
  - Marginal utility of additional information is the expected utility that will be received if the voter votes “correctly” instead of “incorrectly”
- Conclusion: Individual voter’s returns from voting “correctly” are infinitesimal. It is not rational to vote since that voter’s vote is not likely to be pivotal

Critique

- Number of eligible voters voting are >> 0
- Model does not take into consideration, the intrinsic utility of the act of voting

The paradox of voter participation? A Laboratory Study - DAVID K. LEVINE and THOMAS R. PALFREY (2005)

- Participation (Voting) Game:
  - Two parties – A and B
  - N_A , N_B and f(.)

Table 1: Expected payoff matrix for individual i of group A.

	Vote	Abstain
$n_A^{-i} > n_B^{-i} + 1$	$H - c_i$	H
$n_A^{-i} = n_B^{-i} + 1$	$H - c_i$	H
$n_A^{-i} = n_B^{-i}$	$H - c_i$	$\frac{H+L}{2}$
$n_A^{-i} = n_B^{-i} - 1$	$\frac{H+L}{2} - c_i$	L
$n_A^{-i} < n_B^{-i} - 1$	$L - c_i$	L

Reference: Herrmann O, Jong-A-Pin R, Schoonbeek L. A prospect-theory model of voter turnout.

The paradox of voter participation? A Laboratory Study

$$P^*_{A,break} = Prob(\text{voter in group } A \text{ breaks a tie})$$
$$= \sum_{k=0}^{N_A-1} \binom{N_A-1}{k}\binom{N_B}{k}(p^*_A)^k(1-p^*_A)^{N_A-1-k}(p^*_B)^k(1-p^*_B)^{N_B-k},$$
$$P^*_{A,create} = Prob(\text{voter in group } A \text{ creates a tie})$$
$$= \sum_{k=0}^{N_A-1} \binom{N_A-1}{k}\binom{N_B}{k+1}(p^*_A)^k(1-p^*_A)^{N_A-1-k}(p^*_B)^{k+1}(1-p^*_B)^{N_B-1-k}$$
$$P^*_{B,break} = Prob(\text{voter in group } B \text{ breaks a tie})$$
$$= \sum_{k=0}^{N_A} \binom{N_A}{k}\binom{N_B-1}{k}(p^*_A)^k(1-p^*_A)^{N_A-k}(p^*_B)^k(1-p^*_B)^{N_B-1-k},$$
$$P^*_{B,create} = Prob(\text{voter in group } B \text{ creates a tie})$$
$$= \sum_{k=0}^{N_A-1} \binom{N_A}{k+1}\binom{N_B-1}{k}(p^*_A)^{k+1}(1-p^*_A)^{N_A-1-k}(p^*_B)^k(1-p^*_B)^{N_B-1-k}$$

The paradox of voter participation? A Laboratory Study

- Size effect – Voter turn out reduces as Total eligible turnout increases
- Competition effect – Turnout expected to be higher in elections expected to be closer
- Underdog effect – The turnout is more for the candidate with fewer supporters
- Experiments:
  - Only varied N_A and N_B . f is fixed
  - N$\in$\{3, 9, 27, 51\}
  - For each electorate size (landslide) $N_B = 2 N_A$ and (tossup) $N_B = N_A + 1$
  - f = uniform distribution from 0 to 55

Predicted Outcomes

N	N_A	N_B	No. of Subjects	No. of Sessions	P^*_A	P^*_B
3	1	2	51	4	.537	.640
9	3	6	81	9	.413	.375
9	4	5	81	9	.460	.452
27	9	18	108	4	.270	.228
27	13	14	108	4	.302	.297
51	17	34	102	2	.206	.171
51	25	24	102	2	.238	.235

Actual Outcomes

N	N_A	N_B	$\widehat{p}_A$	p_A^*	$\widehat{p}_B$	p_B^*
3	1	2	.539 (.017)	.537	.573 (.012)	.640
9	3	6	.436 (.013)	.413	.398 (.009)	.374
9	4	5	.479 (.012)	.460	.451 (.010)	.452
27	9	18	.377 (.011)	.270	.282 (.007)	.228
27	13	14	.385 (.009)	.302	.356 (.009)	.297
51	17	34	.333 (.011)	.206	.266 (.008)	.171
51	25	26	.390 (.010)	.238	.362 (.009)	.235

Behavioral Model of Turnout -Jonathan Bendor, Daniel Diermeier, Michael Ting (2003)

- Non voters – Shirkers
- n_D and n_R
- $I \in \{V, S\}$, where *V = Voters, S = Shirkers, I = Eligible Voter*
- $J \in \{W, L\}$, *J = Outcome, W = Win, L = Loss*
- $\pi_{i,t}(I, J)$, payoff at *t = time step,* for agent *i,*(Normal Form Payoff + shock, $\theta_{i,t}$)
- b_i - c_i payoff if *i* voted for winning side; b_i payoff for shirker on winning side
- $-c_i$ for losing voters and 0 for losing shirkers

- $p_{i,t}(V) \in [0, 1]$, Propensity to Vote
- $a_{i,t}$, aspirations
- ε_p, will not adjust propensity
- ε_a; will not adjust aspirations

Propensities

(P1) (positive feedback). For all i, t, and action $I \in \{S, V\}$ chosen by i in t:

- if $\pi_{i,t} \geq a_{i,t}$, then $\Pr(p_{i,t+1}(I) \geq p_{i,t}(I)) = 1$;
- if $\pi_{i,t} > a_{i,t}$ and $p_{i,t}(I) < p_i^{\max}$, then $\Pr(p_{i,t+1}(I) > p_{i,t}(I)) = 1$.

(P2) (negative feedback). For all i, t, and action I chosen by i in t:

- if $\pi_{i,t} < a_{i,t}$, then $\Pr(p_{i,t+1}(I) \leq p_{i,t}(I)) = 1$;
- if $\pi_{i,t} < a_{i,t}$ and $p_{i,t}(I) > p_i^{\min}$, then also $\Pr(p_{i,t+1}(I) < p_{i,t}(I)) = 1$.

Aspirations

(A1) For all i, t:

- if $\pi_{i,t} > a_{i,t}$, then $\Pr(\pi_{i,t} \geq a_{i,t+1} > a_{i,t}) = 1$.

(A2) For all i, t:

- if $\pi_{i,t} = a_{i,t}$, then $\Pr(a_{i,t+1} = a_{i,t}) = 1$.

(A3) For all i, t:

- if $\pi_{i,t} < a_{i,t}$, then $\Pr(\pi_{i,t} \leq a_{i,t+1} < a_{i,t}) = 1$.

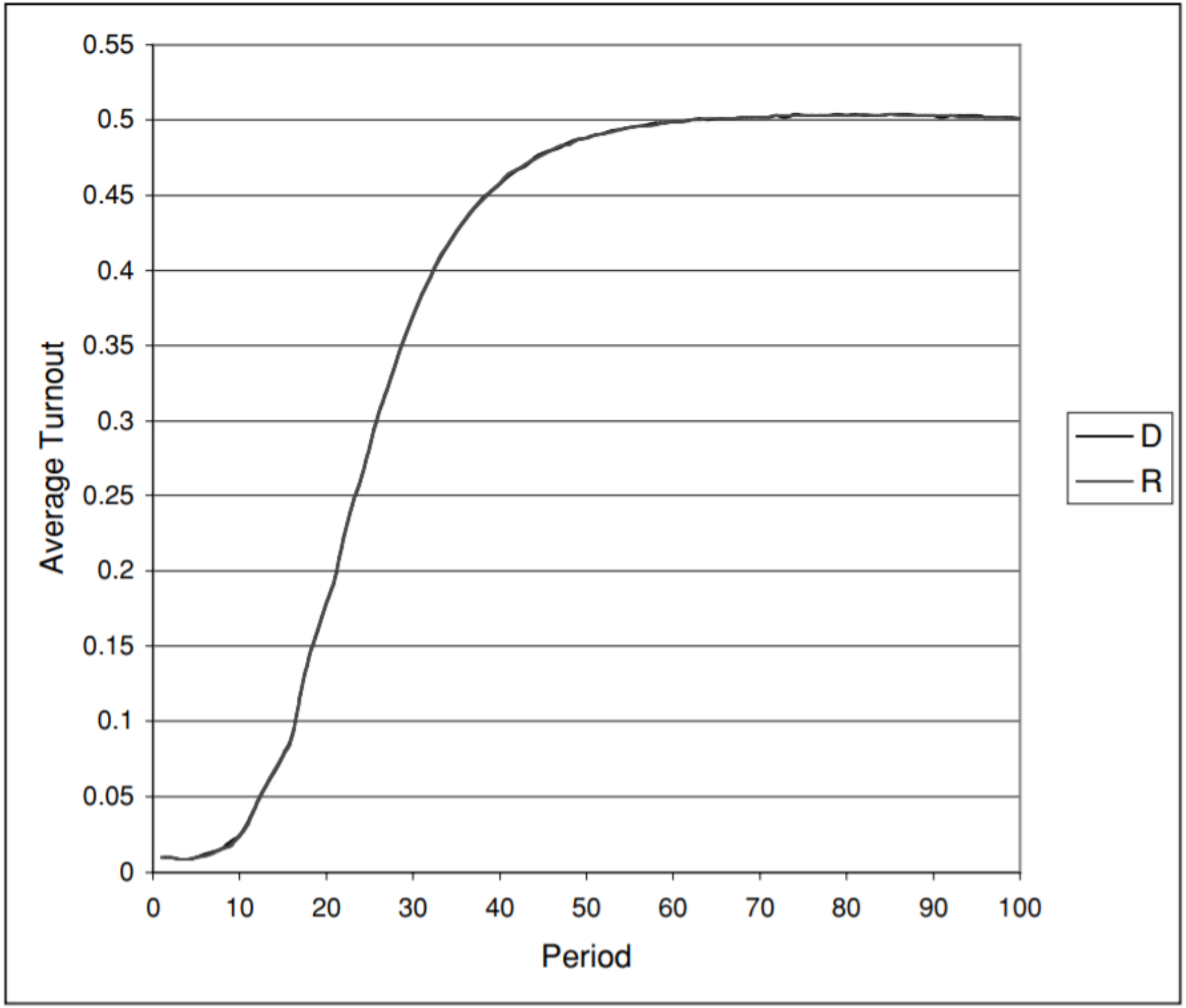
- $p_{i,t+1}(I) = p_{i,t}(I) + \alpha(1 - p_{i,t}(I)),$ Propensity update for winning side
- $p_{i,t+1}(I) = p_{i,t}(I) - \beta p_{i,t}(I),$ Propensity update for losing side
- $a_{i,t+1} = \lambda a_{i,t} + (1 - \lambda)\pi_{i,t},$ Aspiration update for winners and losers

Experiment

- 500,000 Democrats, 500,000 Republicans
- Stabilizes at 50% turnout

Starting Values: 100 Periods
1,000 Simulations

Faction	D	R
Population	5,000	5,000
b	1.0	1.0
c	0.25	0.25
Aspirations	–0.2	–0.2
Vote Propensities	0.01	0.01



Altruism and Turnout - James H. Fowler

- Voters will vote if PB > C,
  - P = Probability of winning
  - B = Payoff from winning
  - C = Cost of voting
- Incorporate Altruism: $P(B_S + \alpha N B_O) > C.$
  - B_S - Payoff for benefit to oneself
  - B_o - Average payoff to rest of the population
  - α – measure of altruism

Altruism and Turnout: Dictator Game

- Camerer (2003) shows that the mean allocation to player 2 ranges from 10% to 52%.
- $U(\pi_s, \pi_o) = (\pi_s^\rho + \alpha\pi_o^\rho)^{1/\rho}$, Utility function from dictator game

Experiment

- 235 subjects were recruited from two introductory undergraduate political science courses
- Subjects were asked whether or not they voted in the March 2004 California primary
- Played the dictator game
- Asked to put themselves along the 7 point scale. 1 being democrat and 7 being Republican

	Model (1)				Model (2)			
	Coef.	S.E.	95% C.I.		Coef.	S.E.	95% C.I.	
Altruism	.5	(.7)	−.9	1.8	−4.4	(2.2)	−8.8	−.1
Strength of Party ID	2.1	(.7)	.9	3.6	.1	(1.0)	−1.8	2.3
Altruism*Str. Party ID					**6.3**	**(2.7)**	**1.0**	**11.6**
Constant	−3.0	(.6)	−4.2	−1.9	−1.5	(.8)	−3.1	−.1

Future Work

- Improve reinforcement learning based model to get better results
- Formulate voting policies that might encourage voting and evaluate those policies

Reference

- Economic Theory of Political Action in a Democracy - Anthony Downs (1957)
- The paradox of voter participation? A Laboratory Study - DAVID K. LEVINE and THOMAS R. PALFREY (2005)
- Behavioral Model of Turnout -Jonathan Bendor, Daniel Diermeier, Michael Ting (2003)