From One to Many

When Groups—Not Czars—Make Decisions

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About Us

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Workshop Agenda

8:50 am: Primer: Social Choice Mechanisms

- *Review of voting methods*
- *Examples of how rules influence results.*

9:15 am: Hands-On Voting

- *Presenting six investment choices for decision.*
- *Prioritizing these choices using different voting methods.*

9:35 am: Discussion

- *Which would you choose for formal group decisions?*
- *What did you like and dislike about each?*

9:45 am: Adjourn

3

Two bad ways for groups to choose

Designate a dictator

Unstructured debate

4

A Better Way: Voting

- If **K = 2**, majority rule almost universally accepted.
- If **K ≥ 3**, things get very messy.
- We will focus on voting systems for K ≥ 3 choices.

5

Technical Factors in Social Choice

- **Kenneth Arrow's "Impossibility Theorem"**
  - *Always produces a winner.*
  - *No rank reversal.*
  - *Unanimity rule.*
  - *No dictator.*
- **Strategic Voting**
  - *Vulnerable to manipulation.*
- **Dueling Criteria**
  - *How often do they happen?*
  - *When do they matter?*


COMMENT

Compare voting systems to improve them

Nature, 12 January 2017, Vol 541, pages 151-153.

6

Human Factors in Social Choice

- Ease of use.
- Frustrations.
- Ability to express one's viewpoint.
- Understanding how the method works.
- Ultimate effect on participation.

None of these are considered in the literature or tested in reality!

7

Inputs and their Richness of Expression

Inputs (Voting Method)	Calculating the number of expressions	Number of expressions with K = 5 Candidates
Choose (Select 1 candidate)	K	5
Approve (Select all whom you approve)	2^K	32
Rank (1, 2,3..K)	K!	120
Grade (A, B, C, , E, F)	N^K For N grades (A,B,C etc.)	7776 with N = 6 grades (> 1 million allowing +/-)
Distribute (Spread 100 points)	M!/[K! * (M-K)!]	73.5 million for M = 100
Score (0 to 100)	M^K	10 billion if M = 99

The Inputs

- **Choose**
  - Select 1 candidate
- **Approve**
  - Select all whom you approve
- **Rank**
  - 1,2,3…K
- **Grade**
  - Categorically, A, B, C, D, E, F
- **Distribute**
  - Spread 100 points
- **Score**
  - 0 to 100

The Algorithms

- **Totals or means**
  - **Runoff**
  - **Score-summing**
- **Truncated means**
- **Medians**
- **Pairwise majority**
- **Other complex mathematical systems**

9

Combining Inputs and Algorithms

- **Choose:** Plurality of votes or runoff election.
- **Approve:** Total approvals.
- **Rank:** Borda Count, Instant Runoff, Coombs, Nanson, Baldwin, and many others (score-summing), Condorcet (also Copeland), and Bucklin. Many other variants.
- **Grade:** Medians with tie-breaking rules.
- **Distribute:** Point summing.
- **Score:** Sums of 0 to 100 scores.

10

Rules Matter: A Demonstration

# Voters			
7	5	4	3
A	B	D	C
B	C	B	D
C	D	C	A
D	A	A	B

- **A,** most-liked and most-disliked.
- **B,** generally well-liked, disliked by few.
- **C,** neither liked a lot nor heavily disliked.
- **D,** similar to A, either liked or disliked a lot, but not as much as A.

Source: https://plato.stanford.edu/entries/voting-methods/

11

Vote for One

# Voters			
7	5	4	3
A	B	D	C
B	C	B	D
C	D	C	A
D	A	A	B

Plurality: A wins (7 votes)

Run-off: A defeats B (10 votes to 9)

Final Ranking: A > B > D > C

What happens if 3 voters drop out of the runoff election due to disgust for choice? (Winner: B not A!)

12

Plurality vs. Runoff: Gore vs. Bush in US 2000 Presidential Election

- Florida's outcome determined the final Electoral College winner
- The actual vote totals:
  - Bush 2,912,790 (48.84682%)
  - Gore 2,912,253 (43.83782%))
  - Nader 97,488
  - All others 40,579 (split approximately evenly between far left and far right)

> 537 votes (of 5.9 million)

- Presence of Ralph Nader tipped Florida to Bush
- If runoff had been used, Gore almost certain winner
  - and hence, US President

13

Using Ranks: Borda Count

A's total: 7*3 + 3*1 + 0 * 9 = 24
B's total: 5*3 + 11*2 + 0*1 + 3*0 = **37**
C's total: 3*3 + 5*2 + 11*1 + 0*0 = 30
D's total: 4*3 + 3*2 + 5*1 + 7*0 = 23

Final Ranking: B > C > A > D

# Voters			
7	5	4	3
A	B	D	C
B	C	B	D
C	D	C	A
D	A	A	B

14

Using Ranks: Condorcet Rule

- No Condorcet winner exists with this voter profile (10 votes needed to win)

  - A vs. B: **A wins** 10-9
  - A vs. C: **C wins** 12-7
  - A vs. D: **D wins** 12-7
  - B vs. C: **B wins** 16 -3
  - B vs. D: **B wins** 12-7
  - C vs. D: **C wins** 15-4

- **A wins against B but loses to C and D**
- **B wins vs. C and D but loses to A**
- **C wins against A and D, but loses to B**
- **D wins against A but loses to B and C**

# Voters			
7	5	4	3
A	B	D	C
B	C	B	D
C	D	C	A
D	A	A	B

15

Duncan Black Rule

- **Use Condorcet first**
- **If no Condorcet winner, use Borda Count**

- **Factoid: Duncan Black (1908-1991)**
  - **Born in Motherwell, Scotland (near here).**
  - **Undergraduate (physics and economics) and PhD (economics) degrees Univ. of Glasgow.**
  - **Major figure in social choice theory.**

16

Serial Elimination with Ranks

- **Instant Runoff**
  - Drop candidate with fewest first place votes.
- **Coombs Method**
  - Drop candidate with most last place votes.
- **Nanson's Rule**
  - Drop candidates with below average Borda count.
- **Baldwin's Rule**
  - Drop candidate with lowest Borda count.

Very similar rules → very different winners!

17

Methods Absolutely Matter!

# Voters			
7	5	4	3
A	B	D	C
B	C	B	D
C	D	C	A
D	A	A	B

- **Plurality Voting: A > B > D > C**
- **Runoff Voting: A > B > D > C**
- **Borda Count: B > C > A > D**
- **Condorcet Voting: No winner**
  - **Duncan Black Rule: If no winner, use Borda**

- **Instant Runoff: D > A > B > C**
- **Coombs Rule: B > C > D > A**
- **Nanson Method: B > C > > A > D**
- **Baldwin Voting: A > B > C > D**

18

"Phelps Rule"

- Use Borda Count, but make last place = -3, not zero

A's total: 7*3 + 3*1 + -3 * 9 = = -3
B's total: 5*3 + 11*2 + 0*1 + -3*3 = 28
C's total: 3*3 + 5*2 + 11*1 + 0*0 = **30**
D's total: 4*3 + 3*2 + 5*1 -3*7= 2

Final Ranking: C > B > D > A

We finally have a rule where C wins!

# Voters			
7	5	4	3
A	B	D	C
B	C	B	D
C	D	C	A
D	A	A	B

19

Other Voting Methods

- **Four new voting methods that different inputs**
  - **Approval voting** – indicate all of which you approve
  - **Dotmocracy** – assign 100 points across the candidates
  - **Range voting** – assign 0 – 100 points to each candidate
  - **Majority judgment** – grade each candidate (A,B,…. F)
- **Probably novel to you.**
- **Not influenced by Arrow's Impossibility Theorem**
  - Arrow's theorem presumes rank order inputs

20

PART III: Putting it in Practice

We will now ask you to prioritize 6 hypothetical interventions using the following voting methods:

1. **Vote for One (choosing)**
2. **Approval Voting (approving)**
3. **Rank Order (ranking)**
4. **Dotmocracy (assigning)**
5. **Range voting (scoring)**
6. **Majority Judgment (grading)**

21

Implied Consent

- **We plan on using these voting results to analyze how people feel about human factors in voting methods.**
- **By completing the ballots in this workshop, you consent to our using your data in our analyses.**
- **Any results reported will be completely anonymous.**

22

A Realistic Scenario

- **You are a deciding authority in the U.K. National Health Services.**
- **Your fixed budget will cover one or more, but not all of the options under consideration.**
- **Your priority order will determine final investments for the public programs.**

23

Critical Investment Choices in your Portfolio

1. **Imaging Technology** (e.g., new PET, CT, MRI scanners) across the health system.
2. **Drug R&D** to delay **Alzheimer's** onset by 5 years.
3. **Public health program** for weight loss and smoking cessation.
4. Priority funding for **research** on Huntington's disease gene therapy through Medical Research Council.
5. **Vaccines** to prevent Ebola.
6. Increase clinical **staffing** by 10 percent.

24

First Ballot: Vote For One

Instructions

Mark your ballot with an X beside your favorite.

Algorithm

Priority will be determined by the number of votes received by each option.

Second Ballot: Approval Voting

Instructions

- Mark your ballot with an X beside each that you approve of (from one to six).
- In your own words, describe what “approve” means to you.

Algorithm

Priority to be determined by total number of approvals for each option.

Third Ballot: Rank Order

Instructions

- Rank the choices from 1,…. 6 on your ballot
- No ties are allowed.

Algorithm

Priority to be determined using Borda count.

Fourth Ballot: Dotmocracy

Instructions

- Allocate a total of 100 points across the available choices.
- If you add wrong, we'll correct the total using same proportions.

Algorithm

Ranking to be determined by total points assigned to each choice across all voters.

Fifth Ballot: Range Voting

Instructions

- Assign a score (0 to 100) for each choice (If you assign no score, we will assume it is zero).
- In your own words, tell us what 0 and 100 mean.

Algorithm

Ranking will be determined by total points assigned to each choice.

Sixth Ballot: Majority Judgment

Instructions

- Grade every choice using the following grades

A= Excellent	D = Fair
B = Very Good	E = Poor
C = Good	F = Unacceptable

(You need not use every grade. You may assign same grade to multiple choices. If you wish, you may add +/- designations to any grade).

Algorithm

Ranking to be determined by median grades, using standard “teeter-totter” methods to break ties when two or more choices have same median grade.

Survey: Human Factors Feedback

- Ease of use
- Ability to express preferences.
- Understanding how the method works.
- Which would you use (and recommend to others) in practice?

31

Take Home Message

- Choice of voting method can alter the outcome.
- Human factors need more attention.
- Homework: How do you pick a voting method to choose among voting methods?

(Answer: Out of thin air!)

32

Thank you for your participation!

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