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

Two bad ways for groups to choose

Designate a dictator

Unstructured debate
A Better Way: Voting

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

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?

**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!

**Inputs and their Richness of Expression**

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

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.
Rules Matter: A Demonstration

<table>
<thead>
<tr>
<th># Voters</th>
<th>7</th>
<th>5</th>
<th>4</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>D</td>
<td>C</td>
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<td>A</td>
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<td>B</td>
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- **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/

Vote for One

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!)

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

Using Ranks: Borda Count

A’s total: $7 \times 3 + 3 \times 1 + 0 \times 9 = 24$
B’s total: $5 \times 3 + 11 \times 2 + 0 \times 1 + 3 \times 0 = 37$
C’s total: $3 \times 3 + 5 \times 2 + 11 \times 1 + 0 \times 0 = 30$
D’s total: $4 \times 3 + 3 \times 2 + 5 \times 1 + 7 \times 0 = 23$

Final Ranking: B > C > A > D

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<td>C</td>
<td>A</td>
<td></td>
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<tr>
<td>D</td>
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<td>A</td>
<td>B</td>
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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

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.
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!

Methods Absolutely Matter!

• 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

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• Instant Runoff: D > A > B > C
• Coombs Rule: B > C > D > A
• Nanson Method: B > C > > A > D
• Baldwin Voting: A > B > C > D
“Phelps Rule”

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

A’s total: $7 \times 3 + 3 \times 1 + -3 \times 9 = -3$
B’s total: $5 \times 3 + 11 \times 2 + 0 \times 1 + -3 \times 3 = 28$
C’s total: $3 \times 3 + 5 \times 2 + 11 \times 1 + 0 \times 0 = 30$
D’s total: $4 \times 3 + 3 \times 2 + 5 \times 1 -3 \times 7 = 2$

Final Ranking: C > B > D > A

We finally have a rule where C wins!

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
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)

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.
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.

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.
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
  B = Very Good
  C = Good
  D = Fair
  E = Poor
  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?

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!)
Thank you for your participation!

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