Session 7: Morning

ABM Applications in International Studies
Part I: Applications of ABM to comparative politics
  ➤ Research Design
  ➤ ABM methods
  ➤ Presentation

Part II: Applications to international relations
Part I

ABM Applications (I): Comparative Studies
“Comparative” Method

- Comparative politics: within states
  - Factors
    - Culture
    - Political Institutions
    - Collective action dynamics
  - Questions
    - Modernization and economic development
    - Political institutional development
- International relations: between states
Research Questions

- **Bennett (2008):** effect of direct vs. indirect tactics on insurgencies
- **Bhavnani (2003):** institutional effectiveness and social capital in Italy
- **Geller and Moss (2008):** neopatrimonialism in Afghanistan
- **Lustick et al. (2004):** repression, responsiveness and secessionism
Research Questions

- Notice policy relevance
  - Clan politics in Afghanistan
  - Secessionism in many states
  - Insurgencies in Iraq, Afghanistan
  - Democratization and civil society
“Emergence”

- Bennett
  - sustained or total insurgency

- Bhavnani
  - social capital or “civicness”

- Geller and Moss
  - *qawm* or neopatrimonial networks

- Lustick et al.
  - ethnic mobilization, secessionist activity, secessionism
Research Design

> Hypothesis Tests
  > “Fitness landscape” (Bennett)
  > Path history (Bhavnani)
  > Network analysis (Geller and Moss)
  > Statistical tests (Lustick et al.)
Hypothesis Tests

Bennett 2008, figs. 7 and 10
Model Construction

➤ Deductive
  – Bennett
  – Luctick et al.

➤ Inductive
  – Geller and Moss: “evidence-based model”
  – Bhavnani
Agents

"Light"

Bennett

Bhavnani

Geller and Moss Lustick et al.

"Heavy"

5th am Intro
5th pm NetLogo
7th am Theory
7th pm Modeling
12th am Emergence
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14th pm Experiments
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19th pm Validation
21st am Smart Agents
21st pm Networks
26th Applications
28th Presentations

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Number of Simulations

- Bennett: $n = 2,750$
- Lustick et al.: $n = 1,700$
- Bhavnani: $n = 60$
- Geller and Moss: $n = 10$?
Research Design

- Sensitivity Analysis
  - Explicit (Bennett)
  - Implicit
    - Bhavnani (boundaries vs. none)
  - None (Geller and Moss; Lustick et al.)
Research Design

- Validation
  - Compare to target system
    - Geller and Moss
  - Compare to other findings ("docking")
    - Bhavnani
  - Speculative
    - Bennett
    - Lustick et al.
Simulated Processes (1)

- Recruitment
  - Insurgencies, *qawm*, secessionist movement
- Feedback loops, tipping points
  - Soldiers and insurgents
  - Governments and secessionists
  - Civicness and historical shocks
- “Tag flipping”
  - Geller and Moss: “endorsements”
  - Bhavnani: four cultural features
  - Lustick et al.: twenty identities
Simulated Processes (2)

- **Lock-in**
  - Insurgencies (Bennett)
  - Social networks (Geller and Moss)

- **Interactive effects**
  - Accuracy and effectiveness of military operations (Bennett)
  - Repression and representation (Lustick et al.)
Other ABM Methods of Note

- Actor heterogeneity
  - Seed values drawn from distributions
- No centralized direction
  - Bennett: no “master insurgent”
  - Geller and Moss: no “clan leader”
  - Lustick et al.: no “seccessionist”
- No genetic algorithms
- You have all the skills
Questions?
Figures

- **Process/flow diagram** (Bhavnani fig. 5)
- **Screen captures** (Bennett fig. 2; Bhavnani fig. 4; Lustick et al. fig. 1)
- **Time series** (Bennett fig. 3; Bhavnani fig. 7; Geller and Moss, fig. 4)
5th am Intro
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Time Series

Geller and Moss 2008, fig. 4
5th am Intro
5th pm NetLogo
7th am Theory
7th pm Modeling
12th am Emergence
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Bennett 2008, fig. 6

Bhavnani 2003, fig. 8

Lustick et al., fig. 1
Pseudo code

- In text (Bennett)
- In appendix (Bhavnani, Lustick et al.)
- None (Geller and Moss)
Extensions

- In text (Bennett)
- In conclusions (Bhavnani, Lustick et al.)
- None (Geller and Moss)
Random Notes of Interest

- Toolkits
  - RePast
    - Bennett
  - PS-i
    - Lustick et al.
  - Other?
    - Bhavnani; Geller and Moss

- Defense of ABM as a method
  - Lustick et al. are excellent
Questions?
Part II

Applications to International Relations

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Research Questions

- Axelrod and Bennett (1993): alignments of states
- Cederman (2003): size of war
- Earnest (2008): the three-choice problem
Axelrod & Bennett
- Stable (i.e. unchanging) alignments

Cederman
- Frequency of large war

Earnest
- Cycling majorities

“Emergence”
Research Design

- Hypothesis Tests
  - P-values (Axelrod & Bennett)
  - Frequency distribution, goodness of fit (Cederman)
    - Note: no F-tests
  - Genetic algorithm (Earnest)
Hypothesis Tests

FIGURE 6. Simulated Cumulative Frequency Distribution In the Representative Sample Run

\[
\log P(S > s) = 1.68 - 0.64 \log s
\]

\[R^2 = 0.991 \quad N = 218\]

Cederman 2003, p. 142
TABLE 1. Replication Results Based on 15 Runs of Each System

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
<th>Range  (Median)</th>
<th>N Wars (Median)</th>
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</thead>
<tbody>
<tr>
<td><strong>Slope Coefficient D</strong></td>
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<td><strong>Main results</strong></td>
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</tr>
<tr>
<td>1. Base runs</td>
<td>-0.64</td>
<td>-0.55</td>
<td>-0.49</td>
<td>0.975</td>
<td>0.991</td>
<td>0.996</td>
<td>4.2</td>
<td>204</td>
</tr>
<tr>
<td>2. Smaller shocks</td>
<td>-0.71</td>
<td>-0.62</td>
<td>-0.56</td>
<td>0.968</td>
<td>0.980</td>
<td>0.993</td>
<td>3.7</td>
<td>267</td>
</tr>
<tr>
<td>3. No shocks</td>
<td>-1.43</td>
<td>-1.32</td>
<td>-1.17</td>
<td>0.878</td>
<td>0.941</td>
<td>0.975</td>
<td>1.4</td>
<td>132</td>
</tr>
<tr>
<td>4. No context activation</td>
<td>-1.52</td>
<td>-1.34</td>
<td>-1.20</td>
<td>0.835</td>
<td>0.882</td>
<td>0.934</td>
<td>1.6</td>
<td>696</td>
</tr>
<tr>
<td><strong>Sensitivity analysis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. warShadow=10</td>
<td>-0.69</td>
<td>-0.60</td>
<td>-0.53</td>
<td>0.966</td>
<td>0.990</td>
<td>0.996</td>
<td>4.2</td>
<td>325</td>
</tr>
<tr>
<td>6. warShadow=40</td>
<td>-0.60</td>
<td>-0.50</td>
<td>-0.45</td>
<td>0.970</td>
<td>0.989</td>
<td>0.997</td>
<td>4.2</td>
<td>148</td>
</tr>
<tr>
<td>7. supThresh=2.5</td>
<td>-0.62</td>
<td>-0.53</td>
<td>-0.46</td>
<td>0.965</td>
<td>0.984</td>
<td>0.991</td>
<td>4.3</td>
<td>210</td>
</tr>
<tr>
<td>8. propMobile=0.9</td>
<td>-0.65</td>
<td>-0.58</td>
<td>-0.53</td>
<td>0.954</td>
<td>0.987</td>
<td>0.992</td>
<td>4.3</td>
<td>250</td>
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<tr>
<td>9. distOffset=0.2</td>
<td>-0.72</td>
<td>-0.52</td>
<td>-0.43</td>
<td>0.908</td>
<td>0.990</td>
<td>0.995</td>
<td>4.4</td>
<td>211</td>
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<tr>
<td>10. distSlope=5</td>
<td>-0.60</td>
<td>-0.53</td>
<td>-0.46</td>
<td>0.974</td>
<td>0.986</td>
<td>0.991</td>
<td>4.3</td>
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<tr>
<td>11. nx x ny=75 x 75</td>
<td>-0.67</td>
<td>-0.59</td>
<td>-0.54</td>
<td>0.987</td>
<td>0.993</td>
<td>0.996</td>
<td>4.6</td>
<td>502</td>
</tr>
</tbody>
</table>

Note: See Table A1 for explanations of the parameter names.

Based on runs with shockSize=10 instead of 20.

Cederman 2003, p. 143
Hypothesis Tests

![Graph showing periods of discord over generations.](image)

**Legend:**
- mean
- median

**Reference:** Earnest 2008, p. 374
**Model Construction**

- **Deductive**
  - Earnest

- **Inductive**
  - Axelrod & Bennett
  - Cederman
5th am Intro
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Agents

“Light”
Axelrod & Bennett
Cederman

“Heavy”
Earnest

26 July: AM
Number of Simulations

- Axelrod & Bennett: $n = 65,536$
- Cederman: $n = 165$
- Earnest: $n = 3,200$
Research Design

➤ Sensitivity Analysis

➤ Explicit
  ➤ Cederman (manual)
  ➤ Earnest (Miller’s ANT method)

➤ None
  ➤ Axelrod & Bennett
Research Design

➤ Validation
  ➤ Compare to target system
    ➤ Axelrod & Bennett
    ➤ Cederman
  ➤ Compare to other findings (‘‘docking’’)
    ➤ Earnest
Axelrod & Bennett, p. 223

<table>
<thead>
<tr>
<th>Configuration 1</th>
<th>Configuration 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment 1</td>
<td>Alignment 2</td>
</tr>
<tr>
<td>Britain (7.45)</td>
<td>Germany (11.49)</td>
</tr>
<tr>
<td>France (5.32)</td>
<td>Italy (4.03)</td>
</tr>
<tr>
<td>Czechoslovakia (1.15)</td>
<td>Poland (1.83)</td>
</tr>
<tr>
<td>Denmark (0.20)</td>
<td>Romania (0.78)</td>
</tr>
<tr>
<td></td>
<td>Hungary (0.45)</td>
</tr>
<tr>
<td></td>
<td>Portugal (0.27)</td>
</tr>
<tr>
<td></td>
<td>Finland (0.19)</td>
</tr>
<tr>
<td></td>
<td>Latvia (0.13)</td>
</tr>
<tr>
<td></td>
<td>Lithuania (0.10)</td>
</tr>
<tr>
<td></td>
<td>Estonia (0.06)</td>
</tr>
<tr>
<td>Alignment 2</td>
<td>(None)</td>
</tr>
<tr>
<td>Soviet Union (15.01)</td>
<td></td>
</tr>
<tr>
<td>Yugoslavia (0.59)</td>
<td></td>
</tr>
<tr>
<td>Greece (0.35)</td>
<td></td>
</tr>
<tr>
<td>Nearest empirical match†</td>
<td>Allies (and those invaded by Germany)</td>
</tr>
</tbody>
</table>

*The size is shown in parentheses, in terms of percentage of world capabilities. The predictions are based upon 1936 data.
†In Configuration 1, only Poland and Portugal are wrong.
Cederman 2003, p. 136

Source: COW data.

Cederman 2003, p. 142

Source: COW data.
Simulated Processes (1)

- Aggregation
  - Axelrod & Bennett
  - Cederman: “Self-organized criticality” or SOC

- Recruitment
  - Formation of alliances

- Feedback loops, tipping points
  - Between levels in a two-level game (Earnest)
Simulated Processes (2)

➤ Lock-in
  ➤ Landscape minima (Axelrod and Bennett)
  ➤ Social choices (Earnest)

Axelrod & Bennett, p. 215

Fig. 4. An Example of a Coordinated Social Choice at $t = 24$

Earnest 2008, p. 376
Other ABM Methods of Note

- Actor heterogeneity
  - Seed values drawn from distributions (Cederman)
  - Functional differentiation (Earnest)

- No centralized direction
  - No hegemons or “great powers” in any of the three models
Questions?
Figures

- Process/flow diagram (Earnest fig. 1)
- Screen captures (Cederman, figs. 3 and 4)
- Time series (Earnest figs. 2 and 3)
- Distributions (Cederman figs. 7 and 8)
FIGURE 5. The Final State of the Sample Run at Time 10,500

Cederman 2003, p. 142
Metacode

- In text (Earnest)
- In appendix (Cederman)
- None (Axelrod and Bennett)
Extensions

- In text (Axelrod and Bennett)
- In conclusions (Cederman, Earnest)
Random Notes of Interest

- “Boundary effects” (Cederman)
- Toolkits
  - RePast
  - Cederman
  - NetLogo
  - Earnest
- Other
  - Axelrod & Bennett
Final Questions?