From Internal Validation to Sensitivity Test: How Grid Computing Facilitates the Construction of an Agent–Based Simulation in Social Sciences

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Validation of Agent–Based Modeling

- Researchers using ABM are expected to:
  1. carefully choose parameters derived from theory (construct validity);
  2. if the theory does not explicate some assumptions or parameters, formulate assumptions based on empirical findings (analytical adequacy);
  3. conduct sensitivity of target parameters.
Sensitivity Test for Internal Validation

- For internal validation, one can
  1. simply propose that the project using ABM is a special case of analytical modeling;
  2. consult subject matter experts (SMEs) or third-party institute or professionals for approval of model design; or
  3. conduct parameter sweeping.
Parameter sweeping refers to “exploring the kinds of results and behaviors the model is capable of producing to identify the most interesting cases that warrant further exploration.”

Sensitivity test is a smaller scale of parameter sweeping; the former means basic inputs are varied in a single direction, while latter means basic inputs are varied in systematic ways.
SRAS, the model
Initialize Party ID, Opinion, and Voter Preferences

Create a Contact List of 8 Discussants

Self-Select Favorite News Media Object

Access the News Media Object?

Yes

Reinterpret the Message?

Yes

Ignore and Store Nothing

No

Find a Contact

No

Want to Talk?

Yes

Find a Contact

No
Test Two Parameters: TP and MP

- We vary the parameter values of TP from 0.0 to 1.0 with increments of 0.1, while fixing the value of all other parameters. We then vary MP from 0.0 to 1.0.
- This results in $11 \times 11 = 121$ sets of parameter combination (to be detailed below). We chose to monitor the proportion of agents and run each set of parameter combination for 70 times, each of which is given a unique seed and runs for 10,000 time steps. This sequence will lead to a total of $11 \times 11 \times 70 = 8,470$ “tulples” or works.
So, How Grid Computing Facilitates Sensitivity Test?
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
<th>Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>duration</td>
<td>How many step to simulate.</td>
<td>10,000</td>
</tr>
<tr>
<td>worldXSize</td>
<td>The column size of the world.</td>
<td>40</td>
</tr>
<tr>
<td>worldYSize</td>
<td>The row size of the world.</td>
<td>40</td>
</tr>
<tr>
<td>GUIshots</td>
<td>Take a shot at the end</td>
<td>0</td>
</tr>
<tr>
<td>numMedia</td>
<td>How many media in simulation.</td>
<td>2</td>
</tr>
<tr>
<td>propExperts</td>
<td>The proportion of citizen2 in the model</td>
<td>0</td>
</tr>
<tr>
<td>propYES</td>
<td>The proportion of favoring &quot;YES&quot; for citizen1.</td>
<td>0.5</td>
</tr>
<tr>
<td>c1CHECKMEDIA</td>
<td>Citizen1 can access media or not.</td>
<td>1</td>
</tr>
<tr>
<td>c1Conform</td>
<td>The critical value of Opinion to change Preference</td>
<td>0.5</td>
</tr>
<tr>
<td>memLength</td>
<td>Citizen1’s memory length or the capacity of storing past political information that influences vote preferences</td>
<td>10</td>
</tr>
<tr>
<td>c1TPMax</td>
<td>The maximum proportion of finding somebody to discuss politics of citizen1.</td>
<td>Max=Min [0.0, 1.0]</td>
</tr>
<tr>
<td>c1TPMin</td>
<td>The minimum proportion of finding somebody to discuss politics of citizen1.</td>
<td></td>
</tr>
<tr>
<td>c1ExpertiseMax</td>
<td>The maximum level of expertise of citizen1.</td>
<td>5</td>
</tr>
<tr>
<td>c1ExpertiseMin</td>
<td>The minimum level of expertise of citizen1.</td>
<td>1</td>
</tr>
<tr>
<td>c1MPMax</td>
<td>The maximum proportion of accessing media of citizen1.</td>
<td>Max=Min [0.0, 1.0]</td>
</tr>
<tr>
<td>c1MPMin</td>
<td>The minimum proportion of accessing media</td>
<td></td>
</tr>
</tbody>
</table>
Simulation Results: The Average of Agents Favoring “1”

![Graph showing the average trend over TP values ranging from 0.0 to 1.0. The graph indicates a stable average with some fluctuations, peaking around TP = 0.9.](image-url)
Simulation Results: The Standard Errors of the 121 experiments