Visualizing QCA

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Objects in a QCA Analysis

- Calibrated data sets
- Truth tables
- Consistency/coverage solutions

Goals of QCA Visualization

- Present superset/subset relationships
- Preserve case holism & diversity
- Clarify configurations
- Convey the range of solution complexity

Examples

- Rihoux & Ragin (2008) Config Comp Methods
Calibrated Data: 2x2 Tables

<table>
<thead>
<tr>
<th>National Literacy Rate (LitCr)</th>
<th>Not High</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Democracy Survival</td>
<td>—</td>
<td>BE, CZ, FI, FR, IE, NL, SE, UK</td>
</tr>
<tr>
<td>Democracy Breakdown</td>
<td>ES, GR, IT, PT, RO</td>
<td>AT, DE, EE, HU, PL</td>
</tr>
</tbody>
</table>

- For crisp sets
- Easy to construct
- Easy to interpret, but need to explain necessity/sufficiency
Calibrated Data: Scatterplots

- For fuzzy sets
- Square aspect ratio
- Diagonal reaches frame corners and is same weight
- Easy to construct
- Easy to interpret, but need to explain triangular plots and necessity/sufficiency
Calibrated Data: Radar Charts

- Compare shape of observations, using fuzzy sets
- Compare configurations by aggregating (e.g., min, mean, max) across observations (Meuer, et. al. 2015)
Calibrated Data
Fuzzy set crossed with crisp set

Rank-order plot
(a.k.a., Cleveland dot plot)

DevCr + UrbCr + IndCr

Degree of Democracy Breakdown (BrkFz)

Membership in \neg DevFz \land \neg UrbFz \land \neg LitFz
Consistency/Coverage Solutions

Fiss configuration charts

- Displays all configurations and how they relate
- Simultaneously present parsimonious and intermediate (or complex) solutions
- Order of configurations is up to researcher; grouping by core conditions is just one option
- Instead of numbering configurations, use meaningful names

<table>
<thead>
<tr>
<th>Family Status</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>➕</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>➕</td>
<td></td>
<td></td>
<td>➕</td>
</tr>
<tr>
<td>High School</td>
<td>➕</td>
<td></td>
<td></td>
<td></td>
<td>➕</td>
</tr>
<tr>
<td>College</td>
<td></td>
<td></td>
<td>➕</td>
<td></td>
<td>➕</td>
</tr>
<tr>
<td>Test Scores</td>
<td></td>
<td>➕</td>
<td>➕</td>
<td>➕</td>
<td>➕</td>
</tr>
<tr>
<td>High AFQT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low AFQT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental Income</td>
<td></td>
<td>➕</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Income</td>
<td>➕</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistency</td>
<td>0.92</td>
<td>0.94</td>
<td>0.91</td>
<td>0.92</td>
<td>0.95</td>
</tr>
<tr>
<td>Raw coverage</td>
<td>0.13</td>
<td>0.10</td>
<td>0.14</td>
<td>0.16</td>
<td>0.11</td>
</tr>
<tr>
<td>Unique coverage</td>
<td>0.07</td>
<td>0.02</td>
<td>0.04</td>
<td>0.06</td>
<td>0.03</td>
</tr>
</tbody>
</table>

- Core causal condition present
- Contributory causal condition present
- Core causal condition absent
- Contributory causal condition absent
Consistency/Coverage Solutions

Star charts

- Condition present
  - Condition is part of parsimonious solution
- Condition absent
  - Condition is part of intermediate solution
Consistency/Coverage Solutions
Branching diagrams (dendrograms)
Superset/Subset Relationships

• Venn/Euler diagrams
  - Familiar and easy to interpret, but:
    • Low information density
    • Interpretability decreases as intersections increase
    • Difficult to convey proportionality
    • Programmatically generating area-proportional Euler diagrams with more than 3 sets is an unsolved problem

• Alternatives:
  - Force-directed graphs
  - Galois lattices
  - Linear diagrams
Area-Proportional 2-Set Venns

Set of Countries with Democracy Breakdown

- **Set of Countries belonging to** devfz × indfz × urbfz
  - (a)

- **Set of Countries belonging to** DEVFZ × INDFZ × LITFZ × stbfz
  - (b)

- **Set of Countries belonging to either set** (Full Solution)
  - (c)
Force-directed Graphs
Galois Lattices

- Easy to construct using software (but not by hand)
- Not intuitive; can be difficult to interpret. Will need to interpret for reader.
- Presents superset/subset relationships simultaneously
- Requires crisp sets
- Particularly well-suited for depicting truth tables (QCAViz can include remainders)
Linear Diagrams
Software

- Visualizations presented here were initially produced using a variety of software (primarily Inkscape, GnuPlot, GraphViz, or TikZ)
- Input data (calibrated data, truth tables, consistency/coverage solutions) typically require some processing to be visualized
- Variation in what can be automated, and to what extent; manual work always needed for best results
- Front-end scripts were written in various languages (typically awk, Bash, or Python)
QCAViz

**Goals**
- Focus on (small/medium-N) QCA
- Standardize inputs; automatically convert between objects
- Invoke backends as needed; invisible to user
- Relatively easy to add/update visualizations
- GUI for interactive use
- CLI for scripting

**Workflow**

**Input**
(Calibrated data, truth table, or consistency/coverage solution)

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**Pre-processing**

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**Generate “backend” code**
(GnuPlot, GraphViz, TikZ, etc)

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**Post-processing**

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**Output:**
- Render image, or
- Convert and save to SVG, EPS, etc., or
- Output raw code for producing image