Lessons learned relating qualitative evidence to decision rules in FEARLUS

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Talk outline

- Using qualitative evidence to enhance FEARLUS
- General observations on interpreting qualitative evidence for implementing decision rules
- The potential of ontologies as a mediating formalism between text and code
- The possible role of provenance
Using qualitative evidence

- Lee-Ann Sutherland conducted a series of interviews with farmers and key informants in the Upper Deeside area of Scotland for the CAVES project
- Transcribed interview texts are then analysed using coding software such as NVIVO
- Findings summarised
- Compare findings with current status of FEARLUS
- Prioritise changes to FEARLUS according to
  - Importance of finding
  - Estimated time required to implement changes
- Implement
- Check assumptions with respondents
Issues with validation in CAS and ABM

- Validation generally seen as a statistical measure of predictive performance of a model
  - No real alternative for ‘bendy sheet’ models that just draw a line through some data
- Oreskes et al. 1994 are critical of what they call verification in complex open systems
  - Impossible due to interconnectedness and hence arbitrary choice of system boundary
  - Affirming the consequent:
    - All good models predict the data
    - My model predicts the data
    - Therefore my model is a good model

<table>
<thead>
<tr>
<th></th>
<th>My model is a good model</th>
<th>My model is a bad model</th>
</tr>
</thead>
<tbody>
<tr>
<td>My model predicts the data</td>
<td>Consistent with ‘all good models predict the data’</td>
<td>Consistent with ‘all good models predict the data’</td>
</tr>
<tr>
<td>My model does not predict the data</td>
<td>Inconsistent with ‘all good models predict the data’</td>
<td>Consistent with ‘all good models predict the data’</td>
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Qualitative validation

- Problems validating in complex systems

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</thead>
<tbody>
<tr>
<td>My model predicts the data</td>
<td>...but data are only from one history</td>
<td>Data don’t cover all metastable states</td>
</tr>
<tr>
<td>My model does not predict the data</td>
<td>Initial conditions could be wrong</td>
<td>...but with another rule it might be better</td>
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- Moss and Edmonds (2005)
  - Validate qualitatively at micro level, quantitatively at macro
    - But with enough free parameters, you can usually fit anything...

- Approaches to validation in qualitative social science
  - Triangulation (Bryman 2008)
    - Multiple sources for findings
  - Respondent validation (Bryman 2008)
    - Return the findings to respondents to see what they say
  - Rigorous documentation and application of methods (Silverman 2001)
    - Avoids taking data from their original or intended context
Summary of approach we used

1. Design interview question guide
2. Conduct interviews
3. Interview transcript coding
4. Qualitative research findings
5. Validation of qualitative findings (rigorous application and documentation of methods)
6. Checking of (changes to) model (return to respondents)
7. Pre-existing version of model → Changes to model → New version of model
Example

Finding

- “Due to the high opportunity cost of changing commodities, farmers require several years of poor returns before doing so”

Implementation

```java
if(mean_net_approval >= social_aspiration && profit_per_unit_area >= financial_aspiration) {
    changeYears = 0; // ‘Satisfied’
} else {
    changeYears++;
}
```

```java
if(changeYears < changeDelay) {
    // ‘Habit’ (no change)
} else {
    // Search for best option
}
```
Example continued

- Can’t show code to respondents!

- Check statements with them:
  - Farmers will accept financial losses for several years before changing their crop or type of stock
  - Farmers will continue producing their current crop or type of stock at a small loss, _if they see no viable alternative except leaving the farm_
    - Qualifier checks if search happens to produce existing activity as best outcome

- Strong or general agreement among most of the eight respondents
  - Disagreement: “farmers cannot afford to keep losing money indefinitely”
    - Issue of parameterisation
    - Note also that some small farms are sometimes subsidised by income from off-farm activities
General observations

- Qualitative research tends to use fewer ‘samples’ than quantitative
  - Probably not enough for statistical tests of ‘validity’

- There could be multiple interpretations
  - e.g. Gotts (2009) and Jager & Rangoni (2012) both implement Lindenberg & Steg’s (2007) ‘goal frames’ theory of environmentally relevant decision-making
    - Gotts implements hedonic, norm and gain modes
    - Jager & Rangoni implement hedonic and norm modes

- Could be a heuristic to prefer ‘simple’ implementations
  - Or rather as minimally complex as justifiable
  - Note Edmonds (2002)

- Rigorous documentation may be an important part of ‘validation’
  - e.g. TRACE (Schmolke et al. 2010)
Ontologies as mediating formalisms

- **Ontologies as mediating formalisms**

  - **Domain Structure Ontology**
    - **Model Ontology**
    - **Scenario Ontology**
    - **Representation Ontology**

- **Endurant**
  - Entities that “are ‘in time’, they are ‘wholly present’ (all their proper parts are present) at any time of their existence.” (Masolo, Borgo et al 2003). They are “things” rather than “processes”, contrasting with “Perdurants” – see below.

- **PhysicalEndurant**
  - For example, a tonne of grain, a litre of water.

- **PhysicalThing**
  - Something you could pick up and throw – if you were the right size.

- **PhysicalObject**
  - **LivingThing**
    - **NonHumanOrganism**
      - **DomesticAnimal**
        - Sheep, Cow, etc.

- **Import**
- **Import and subclass**
- **Import**
Linking ontologies to texts

- Identifying ontological entities from text can be conducted as a specialised form of coding exercise
  - N.B. Squanto (Krikikos 2006)

- Qualitative evidence good for eliciting structure

... and back

- NLG
  - e.g. Sun and Mellish (2007)
Provenance as documentation tool

- Pignotti et al. (2011) outlined three kinds of provenance
  - Social process of model development
    - Most relevant here for ‘rigorous documentation’
  - Execution of the model
  - History of a simulation (see also Bennett et al. 2011)

- Combining all three could theoretically tell you which social processes were significant in producing an outcome in a model

- Provenance can be formalised using ontologies
  - e.g. Open Provenance Model (Moreau et al. 2008)
  - PROV-O (W3C draft, July 2012)

- Allows reasoning
Example

- Documenting another change to FEARLUS to add land markets

**foaf:Person**

- "Nick Gotts"
- "Gary Polhill"
- "Dawn Parker"

**opm:Artifact**

- "Land Market Model"
- "FEARLUS 0.8.3"
- "FEARLUS 0.8.4"
- "Meeting Notes"

**opm:Process**

- "Meeting 01/02/2005"
- "Implementation"

**controlledBy()**

- Nick Gotts
- Gary Polhill
- Dawn Parker

**worksWith()**

- Nick Gotts, Gary Polhill
- Nick Gotts, Dawn Parker
- Gary Polhill, Dawn Parker

**collaboratesWith()**

- Nick Gotts, Gary Polhill
- Nick Gotts, Dawn Parker
- Gary Polhill, Dawn Parker

**wasGeneratedBy()**

- Nick Gotts, "Meeting 01/02/2005"
- Gary Polhill, "Implementation"
- Dawn Parker, "Land Market Model"
- Nick Gotts, "FEARLUS 0.8.3"
- Gary Polhill, "FEARLUS 0.8.4"
- Nick Gotts, "Meeting Notes"
Summary

- Qualitative evidence is a natural source for determining model structure
  - Not entirely free of issues of interpretation...
- For determining decision rules there are more significant issues over interpretation
  - How do we convert the evidence into an algorithm?
- (Statistical) validation is more of a challenge with qualitative evidence
  - But how useful is that information anyway?
- Rigorous documentation of methods becomes more important
  - Provenance is one tool to do that