

Intermediate Level Qualitative Comparative Analysis Including Fuzzy Sets

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--Notes for Beginners**

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QCA

- Comparative social research is always substantivist. Please ensure that you create your own data set rather than simply accepting someone else's categorisations as good measures.
- Examples of the use of QCA include Ragin, et al. (2003), Kvist (1999), Levi-Faur (2002), Miethe and Drass (1999), and Snow and Cress (2000) in the AJS. The latter will be used in this presentation.

What About Methodological Problems with a Flat Data Table?

- You have to consider the macro, meso and micro as well as psychological and cultural factors (see Layder, 1991, for a superb overview and guide)
- You place data in one table after allowing for commonalities of experience of the 'units'
- Avoid reductionism

References on Research Design For Complexity

- Blaikie, N. W. H. (2000). Designing social research : the logic of anticipation. Cambridge, Polity Press.
- Layder, D. (1993). New Strategies in Social Research. Cambridge, Polity Press.
- Layder, D. (1998). The Reality of Social Domains: Implications for Theory. Knowing the Social World. T. May, and Malcolm Williams. Buckingham and Philadelphia, Open University Press: 86-102.
- **Ragin, et al. (2003) "Complexity, Generality, and Qualitative Comparative Analysis", *Field Methods*, 15:4, 323-340 (TO BE HANDED OUT)-allows for social and ecological causes**

Your ontology should not be flat

- Byrne, D. (1999). Complexity theory and the social sciences: an introduction. London, Routledge.
- Danermark, B. (2002). Explaining society: critical realism in the social sciences. London, Routledge.
- Sayer, A. (1992). Method in Social Science. London, Routledge.

Illustrative Table 1

- X and Y are associated
- Z is irrelevant here
- S is superfluous
- Examine this table.

Ca ses	X	Y	Z	S
1	1	1	0	1
2	1	1	1	1
3	0	0	0	1
4	0	0	1	1
5	1	1	0	1
6	1	1	1	1
7	0	1	0	1
8	0	1	1	1
9	0	0	0	1

Two ideal types of causality

- X could be a part of Y.
- If X is intrinsically a part of Y, then X co-occurs with Y whenever Y occurs. Being-together is not necessarily what we mean by X causing Y!
- Otherwise X could be independent of Y, yet causal of Y, as 'medical treatment' is thought to be independent of its effects on the patient.

Quiz

- Which of these 2 ideal types is 'natural necessity', and which is 'contingent causality'?
- If X is part of Y then does Y cause X or does X cause Y?

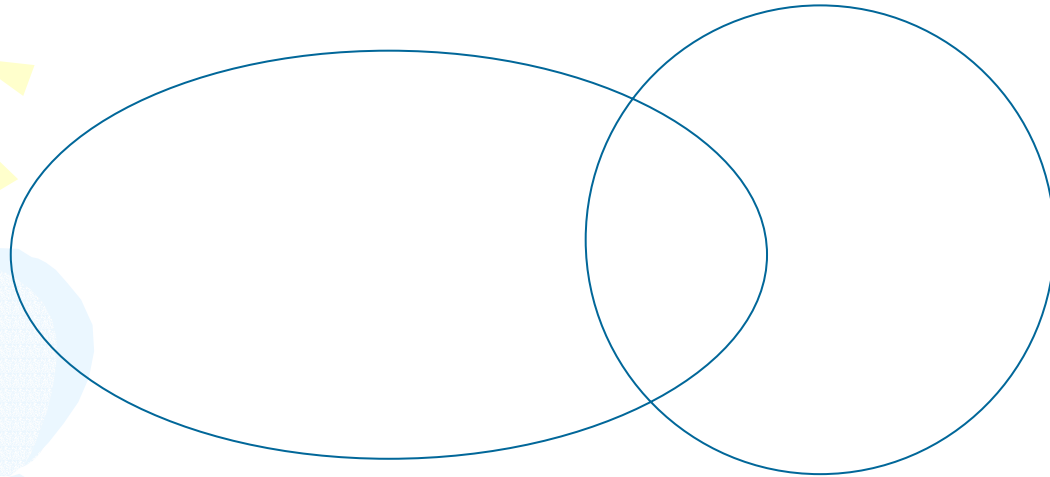
No necessary causality here?

Cases	X	Y	Z	S
1	1	1	0	1
2	1	1	1	1
3	0	0	0	1
4	0	0	1	1
5	1	1	0	1
6	1	1	1	1
7	0	1	0	1
8	0	1	1	1
9	0	0	0	1

Notation for Boolean Algebra

- You need to know Y and not- Y ($Y, \sim Y$)
- The 'and' symbol is usually a $*$ or simply omitted; this is called Boolean Multiplication.
- The 'or' symbol can be a comma or a $+$.
- You can denote X as ORGANIZATION and not- X as organisation (note caps)

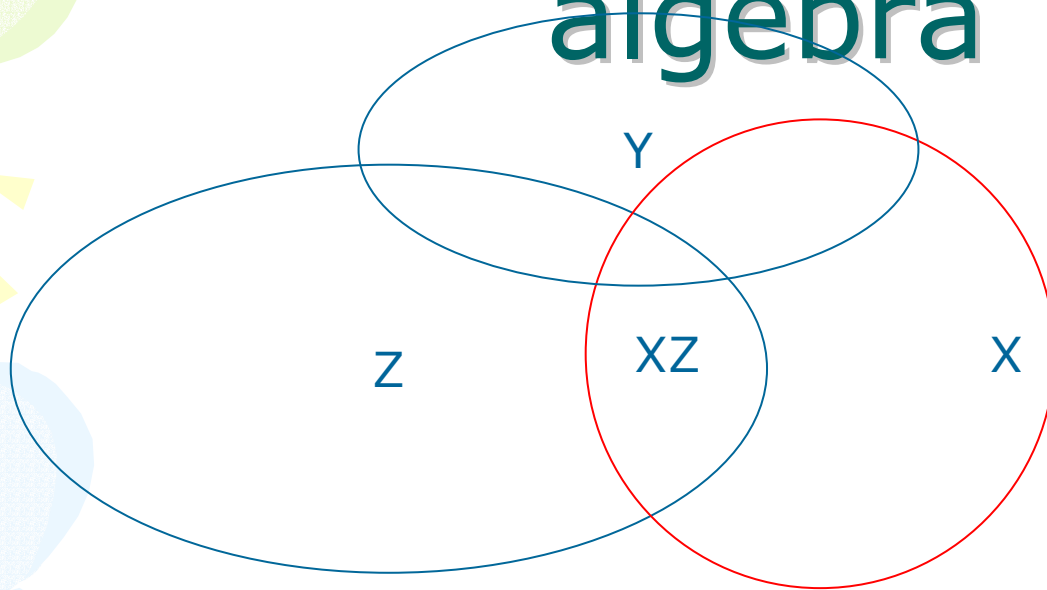
Venn diagrams imply crisp sets.



The intersection is the small area in the middle, represented by AND

The union of the two sets is the whole area circled, ie OR, meaning EITHER-OR!

Venn diagrams and Boolean algebra



The intersection of XYZ is what regression interaction effects would focus upon. It is the tiny area in the middle, X AND Y AND Z.

XZ does not imply $\sim Y$ but it could if there were a 'negative interaction effect'

Causal trajectories

- It could be that:
 - X and Z together could cause Y – e.g. medicine plus positive thinking cause a cure – but Z and X each do not cause a cure.
 - Neither is sufficient for Y but XZ is.
 - Meanwhile P and Q together also cause Y, so XZ is not **necessary** to cause Y. But XZ can still be sufficient to cause Y. No single cause is now 'necessary' in the set.
- Cluster analysis could discover patterns of configurations.
- You would have to interpret them in causal terms.

Doing QCA with Software

- Put your data in SPSS.
- Use only 0/1 variables.
- Save data as a dta file.
- Open this in FS/QCA.
- Run Analyse > Crisp Sets > Quine
- Under SPECIFY,
 - Set positive cases (1) to TRUE
 - Set negative cases (0) to FALSE
 - Set the contradictions to DON'T CARES
- This retains the config's that have both 0's and 1's in the actual data table.

Warning

- You have to set the SPECIFY settings.
- Otherwise you will get the message:
 - Warning: Select configurations to minimise
- This means you have 'excluded' (the default) the Positive cases! The default is rotten so 'specify' must be set.

This is the 'SPECIFY' Screen

File Variables Cases Analyze Graphs

Case school ac5 ag5 nopass

Case	school	ac5	ag5	nopass
1	Joseph Swan School	51	95	2
2	St Edmund Campion Roman Cathol	50	86	4
3	Emmanuel Colleg	95	97	1
4	Heworth Grange Comprehensive S	39	83	11
5	Lord Lawson of Beamish Communi	79	89	3
6	Whickham School	66	97	0
7	Royal Grammar School	97	97	3
8	Central Newcastle High School	100	100	0
9	Walker Technology Colleg	58	76	4
10	Newcastle-upon-Tyne Church Hig	100	100	0
11	St Joseph's RC Voluntary Aided	61	97	2
12	West Gate Community Colleg	21	66	14
13	Dame Allan's Boys' School	97	97	2
14	Dame Allan's Girls' School	97	97	2
15	Sacred Heart High School	65	90	5
16	Heaton Manor School	54	91	4
17	Benfield School	27	79	10
18	St Cuthbert's High School	54	93	5
19	La Sagessse School	97	97	0

File: ne schools full.dat

Slide 14 of 2 Page 1 Sec 1 1/1 At 2.5cm Ln 1 Col 2 REC TRK EXT OVR English (U.S)

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This example

- CATHOLIC = typ3 = 1
- SOCIALLY DEPRIVED = socdep2 = 1
- SELECTIVE SCHOOLS = adpol2 = 1
- SPECIAL NEEDS, or SEN, the number of cases of Statemented special needs, coded crisply ins SPECNEED
- GOOD EXAM PERFORMANCE is coded 0/1 in GOODEXAM (recoded FZplcl2)

Next Steps

- Click on LIST to see the configurations that you have in the data – these actually have cases in them.
- It lists those with TRUE, FALSE, and contradictory results.
- Click on RUN to see the minimised truth table. Here is an example.

The List of Configurations (i)

```
» *****
» * TRUTH TABLE LISTING *
» *****
»
» File: P:/RM2workshops/Workshop2Sept04/ne schools full.dat
» Rows:      3
» Cases:     51
»
»
» Minimum Frequency 0:    1
» Minimum Frequency 1:    1
» Minimum Frequency -:    1
» =====
»
» socdep2 typ3
» Outcome: C Cases:   36  70.6% (0 = 15  1 = 21  - = 0)
»
» SOCDEP2 typ3
» Outcome: 0 Cases:    8  15.7% (0 = 8  1 = 0  - = 0)
»
» socdep2 TYP3
» Outcome: 1 Cases:    7  13.7% (0 = 0  1 = 7  - = 0)
```

- * CRISP-SET ANALYSIS *
- *****
- File: P:/RM2workshops/Workshop2Sept04/ne schools full.dat
- Model: GOODEXAM = SOCDEP2 + TYP3

- Cases Read: 82
- Valid: 82 100.0%
- Missing: 0 0.0%
- 0 Cases: 23 28.0%
- 1 Cases: 59 72.0%
- - Cases: 0 0.0%

- Algorithm: Quine-McCluskey
- 1 Matrix: 1
- 0 Matrix: 0
- - Matrix: C

- *** TRUTH TABLE SUMMARY ***

Configs	%	Cases	%
0 Terms:	0	0.0	0 0.0
1 Terms:	1	33.3	15 18.3
- Terms:	0	0.0	0 0.0
C Terms:	2	66.7	67 81.7
0:		23	
1:		44	
Total:	3	100.0	82 100.0
Dropped:	0	0.0	0 0.0

- *** **CRISP-SET SOLUTION** ***

- **socdep2 GOOD EXAM RESULTS DEPEND UPON not being socially deprived**

The Truth-Table Summary

- Configurations are those which have either a positive or negative outcome, or a Contradictory outcome across cases, but if there were a missing value on the outcome, it would be a “don’t care case” and wouldn’t count here.
- Instances, or “cases” in the truth table, are those with a positive outcome.

Concluding

- Using more terms in the algorithm, you will get more complex solutions like:
 - CATHOLIC&socdep + SEN&comp
 - Which reads: If (CATHOLIC AND not socially deprived) OR (Special Educ. Needs AND not comprehensive) then GOOD EXAM RESULTS

Is absence symmetric with presence?

- In standard Boolean logic with crisp sets, Not-Y is symmetric with Y's presence. The algorithm for reducing the set of configurations that cause Y is dependent upon the absence of Y implying not-Y.
- But if you use Fuzzy Sets, then you lose this symmetry. You have NOT-Y referring to all cases from 0 to .87 ----not just to the 0 values.
- Alternatively one can consider NOT-Y to be from 0 to .5 only. You will need to set cut-off level. Changing the cut-off causes the complex configurations to be merged differently.
- The FS/QCA software ignores the cases which are not 'instances'. (Note the jargon in the manual.)

The Fuzzy Set Equivalent to Boolean Algebra

- We can't simply add up $1 * 1 = 1$ in fuzzy sets, since not all cases are on 1 or 0.
- So now $\{>.5 \text{ to } 1\} * \{>.5 \text{ to } 1\} = 1$

This is the combinatorial algebra used for Boolean logic with fuzzy sets.

AND implies that both must be $>.5$

'OR' in the fuzzy set algebra

- OR is inclusive or
- It allows as a result of X, Y, Z all those cases if either X , or Y , or Z are $>.5$
- Thus this is really inclusive and loose.
- However, XYZ indicating $X \& Y \& Z$ is very exclusive.

Sufficient Cause

- Furthermore, it is necessary to have some cases where Y is present ($>.5$), but X is absent ($.5$ or less), if we want to argue that X is a sufficient cause of Y yet not a *necessary cause*. *These cases negate the claim that X is a necessary cause of Y but they do not negate the claim that it is part of a larger, complex, sufficient cause of Y.*
- Ragin has summarised the possible combinations for multiple X's and Y's but if we use fuzzy sets, then Y $\{.17$ to $1.00\}$ has to be considered separately from NOT-Y (0 to $.83$).

Reminder: The Details of Steps:

- small N of cases
 - compare them deliberately
 - use various types of evidence,
 - summarise the intermediate results in a table
 - reduce the table using Boolean logic – you simplify the table
 - Look for necessary causes
 - Look for sufficient causes
 - Decide whether your outcome was well enough specified or not
 - iterate: move back to earlier steps and re-do it all
 - then draw conclusions.
-
- USE FUZZY ALGORITHM FOR FUZZY SETS all on 0-1 scale
 - Fascinating.

Illustrations of QCA

- Levi-Faur (2002). Comparative Research Designs in the Study of Regulation: How to Increase the Number of Cases Without Compromising the Strengths of Case-Oriented Analysis. The Politics of Regulation. J. Jacint and D. Levi-Faur. London, Elgar.
- Miethe, T. D. and K. A. Drass (1999). "Exploring the Social Context of Instrumental and Expressive Homicides: an Application of Qualitative Comparative Analysis." Journal of Quantitative Criminology **15**(1): 1-21.
- Snow, D. and D. Cress (2000). "The Outcome of Homeless Mobilization: the Influence of Organization, Disruption, Political Mediation, and Framing." American Journal of Sociology **105**(4): 1063-1104.

Taking QCA Further

- Ragin, C. C. (1989). "The Logic of the Comparative Method and the Algebra of Logic." Journal of Quantitative Anthropology **1**(2): 373-398.
- Rantala, K. a. H., Eeva . (2001). "Qualitative Comparative Analysis - a Hermeneutic Approach to Interview Data." International Journal of Social Research Methodology **4**(2): 87-100.

Illustrations of Fuzzy Set

- Kvist, J. (1999). "Welfare Reform in the Nordic Countries in the 1990s: Using Fuzzy-Set Theory to Assess Conformity to Ideal-Types." Journal of European Social Policy 9(3): 231-252.
- Pennings, Paul (2003). "Beyond Dichotomous Explanations: Explaining Constitutional Control of the Executive With Fuzzy-Sets." European Journal of Political Research **42**(4): 541-568.
- Ragin, C. (2000) *Fuzzy Set Social Science* Chicago: University of Chicago Press.

Technical Readings

- If you want to help advance the state of fuzzy set comparative analysis, then read:
- Ragin, C. (2003). "Recent Advances in Fuzzy-Set Methods and their Application to Policy Questions." Copies can be obtained via www.compass.org or from wendy.olsen@man.ac.uk (as a pdf document).
- FUZZY: Schneider, C. Q. and C. Wagemann (2004). "How to Draw Causal Inference (Despite) Using QCA: The 'Two-Step, Multi-Equation FS/QCA Approach'." submitted paper. Copies can be obtained via www.compass.org or from wendy.olsen@man.ac.uk (as a pdf document).