

LCA with restrictions - Chapter 3 Heinen (pp. 65-90)

- restrictions can be placed on the latent class probabilities (p_{θ_t}).
 - used in multigroup analysis
- restrictions can be placed on the conditional response probabilities ($p_{jg|\theta_t}$)
 - $p_{jg|\theta_t} = 1$ or 0 “error free linkage between an indicator and latent variable”
 - equality constraints
 - * $p_{jg|\theta_t} = p_{j'g|\theta_t}$, fix the response probability for different questions (j and j') to be the equal within the same class (t).
 - * $p_{jg|\theta_t} = p_{jg|\theta_{t'}}$, fix the response probability across two classes (t and t') to be equal for the same question (j).
 - * On p. 68, 69 Heinen gives formula for the restrictions in log linear notation as well
 - inequality constraints with respect to conditional response probabilities
 - * “Latent class analysis with ordered classes” Croon 1990, *British Journal of Mathematical Statistical Society*, 43, 171-192.
- Can run into optimization problems with restricted models. Mooijaart and van der Heijden, P. (1992) the EM algorithm for latent class analysis with equality constraints. *Psychometrika*, 57, 261-269.

Restricted models make possible

1. test relation between latent and observed variables
2. multi group comparisons
3. include external variables
4. construct multidimensional latent class models

SOFTWARE NOTE: Besides MPLUS, other softwares that can perform Latent class analysis: MLLSA (Clogg), LCAG (Hagenaars)

Guttman Scale (p. 71 Heinen)

1. dichotomous observed variables
2. hypothesized underlying continuous latent variable
3. each observed variable has the following property

4. each variable has different threshold so that there is a distinct ordering of "difficulty" to the questions

Example from Heinen Table 3.1, Table 3.2 There are only $n + 1$ (i.e. the number of questions plus 1) possible response patterns and they are distinct and so there are $n + 1$ classes (no latent classes).

Coefficient of reproducibility and the coefficient of scalability (Clogg and Sawyer 1981) are measures of how well the Guttman Scale fits the data. **NOT found in MPLUS**

Guttman scale model is too rigid so variants are considered

1. Allow for measurement error - Figure 3.3 in Heinen

- when $a = b$ this is called the Proctor model
- a latent class is associated with each legitimate response pattern then restrictions are placed on all conditional probabilities as in Table 3.3.
- Other methods in Table 3.4 are variants of restrictions on a and b for different observed items
- It is not obvious how to use MPLUS to fit the different models posed in TABLE 3.4 because it is not possible to constrain one parameter to equal a function of another parameter. That is $p_{jg|\theta_t} = a$ while $p_{j'g|\theta_t} = 1 - a$.

2. Drop assumption of homogeneity of populations.

- Basically there is a subset of the population who do not conform to the Guttman scale and are “intrinsically unscalable”
- this adds an additional class of people
- this method suggested by Goodman has been criticized because it yields a high estimate for the proportion in the ”unscalable” class