Welcome to the ESRA course about latent class analysis! Below you will find some questions about different parts of the course. During the course, I will from time to time ask you to answer some of these questions. Please work in pairs or groups and confer with your neighbors about the answer. I will discuss the answer immediately afterwards.

1 Inngangur [Introduction]

1. How can latent class analysis be useful for survey researchers? Please choose all that apply.
   A. To estimate measurement error in categorical survey questions
   B. To estimate measurement error in continuous survey questions
   C. To explore subgroups of respondents with different opinions
   D. As a nonparametric alternative to multilevel models
   E. As a confirmatory model to test theories about constructed scales
   F. To explore differences in regression coefficients over different respondents
   G. As a flexible model for multiple imputation of missing categorical data
   H. As an alternative to K-means clustering

2. What is the difference between "latent class modeling", "latent class analysis", and "(finite) mixture modeling"?
   A. Finite mixture modeling is more general; latent class modeling and analysis apply only to categorical observed data
   B. Latent class modeling is a trademark invented by certain makers of commercial software. Mixture modeling and latent class analysis are general terms that anybody can use
   C. There is no difference. These are synonyms for the same technique

2 Lítið dæmi [Small example]

Terminology! Which of these LCM terms is described below?

1. "The probabilities of choosing a particular response option, given your membership of the latent class"

   ◯ Profile ◯ Likelihood ◯ Class sizes

2. "The overall (or marginal) probabilities that a random person belongs to each latent class."

   ◯ Profile ◯ Likelihood ◯ Class sizes

3. "The joint probability of observing a particular combination of responses on the observed variables, according to the model."

   ◯ Profile ◯ Likelihood ◯ Class sizes

4. Here are the results for the small example again:

	$X = 1$	$X = 2$
$P(X)$	0.620	0.380
$P(Y_1 = 1\|X)$	0.960	0.229
$P(Y_2 = 1\|X)$	0.742	0.044
$P(Y_3 = 1\|X)$	0.917	0.240

   In the data, we observed that 366 out of the 1713 respondents (21.4%) gave the response $Y_1 = 2, Y_1 = 2, Y_1 = 2$, i.e. they felt that anti-religionists should not be allowed to speak, or to teach, and that their books should be removed from the library.

   According to the two-class LCM, what is the expected (model-implied) proportion of people who give such a response?

   $P(Y_1 = 2, Y_1 = 2, Y_1 = 2) =$ _____

5. Suppose that within the class of more tolerant people ($X = 1$), those who allow anti-religionists to speak are also more likely to allow them to teach. Which assumption, if any, would this violate?

   A. Mixture assumption
   B. Local independence assumption
   C. Normality assumption
   D. Linearity assumption
   E. This would not violate any assumption

3 Evaluating model fit and interpreting the output

1. Suppose there are 4 binary (dichotomous) indicators and we fit a 3-class model.

   How many unique (!) response patterns do 4 binary indicators give?

   npat = _____

   How many unique parameters do you need for a 3-class model for 4 binary indicators?

   npar =_____

   How many degrees of freedom does this model have?

   npat - npar = _____

2. Jón fits a series of models with increasing number of classes 1,2,3, . . . After fitting the 40-class model, each model still has a lower BIC and AIC than the previous one.

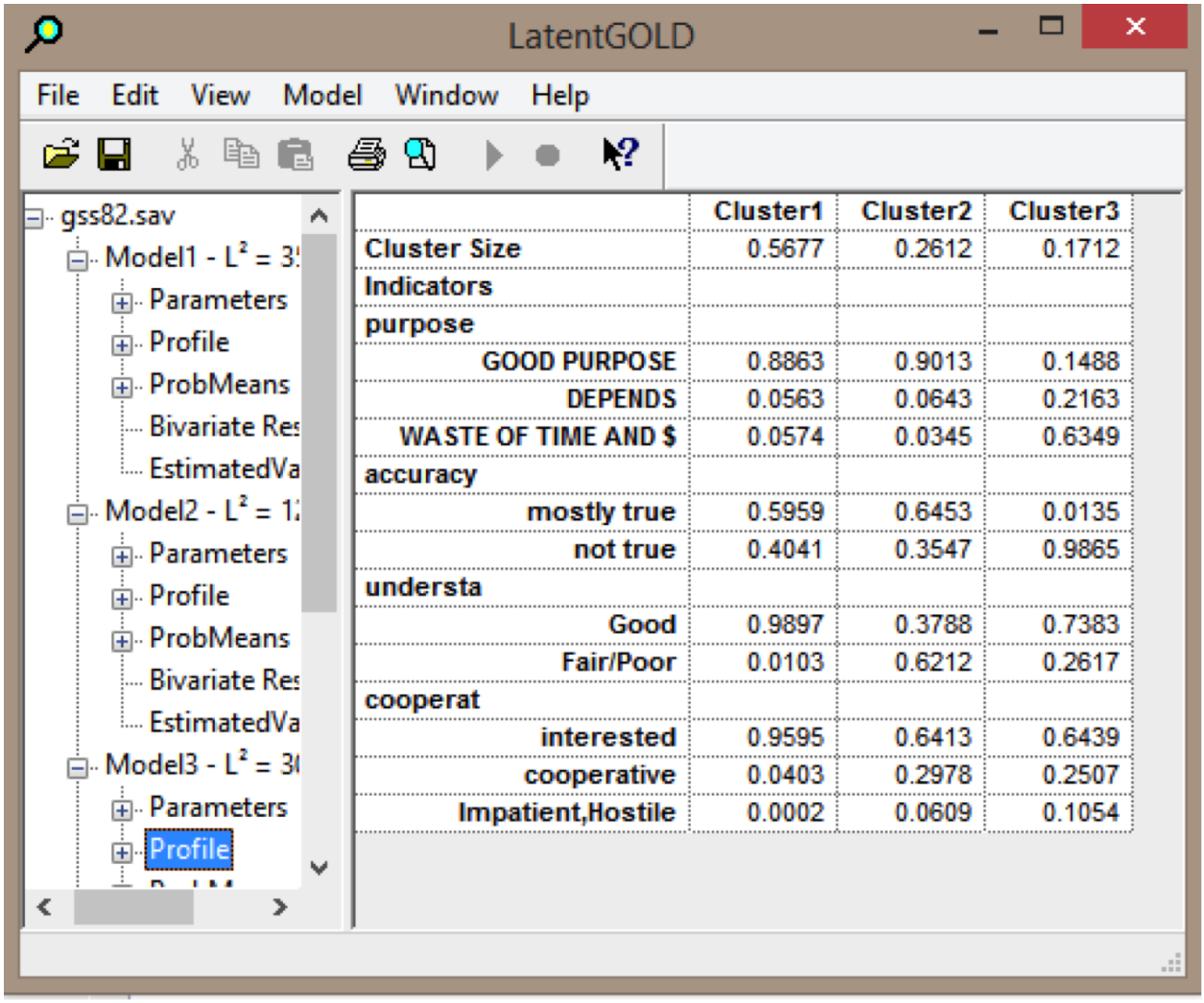
   What, in your opinion, would be Jón best course of action now?

3. Here is an example from the General Social Survey 1982 (see McCutcheon, 1987; Magidson & Vermunt, 2001, 2004).

   Four variables were available

   - Evaluation of surveys by respondent
     1. purpose (3 categories)
     2. accuracy (2 categories)
   - Evaluation of respondent by interviewer
     3 understanding (2 categories)
     4 cooperation (3 categories)

   Based on the profile output below, **name the three latent classes**.



	Cluster1	Cluster2	Cluster3
Cluster Size	0.5677	0.2612	0.1712
Indicators			
purpose			
GOOD PURPOSE	0.8863	0.9013	0.1488
DEPENDS	0.0563	0.0643	0.2163
WASTE OF TIME AND $	0.0574	0.0345	0.6349
accuracy			
mostly true	0.5959	0.6453	0.0135
not true	0.4041	0.3547	0.9865
understa			
Good	0.9897	0.3788	0.7383
Fair/Poor	0.0103	0.6212	0.2617
cooperat			
interested	0.9595	0.6413	0.6439
cooperative	0.0403	0.2978	0.2507
Impatient,Hostile	0.0002	0.0609	0.1054

4 Classification

1. Back to the results from the small example:

	$X = 1$	$X = 2$
$P(X)$	0.620	0.380
$P(Y_1 = 1\|X)$	0.960	0.229
$P(Y_2 = 1\|X)$	0.742	0.044
$P(Y_3 = 1\|X)$	0.917	0.240

   For a person who answers $Y_1 = 2, Y_2 = 1, Y_3 = 2$, what is the posterior probability that they belong to class 2?

   $P(X = 2|Y_1 = 2, Y_2 = 1, Y_3 = 2) =$_____

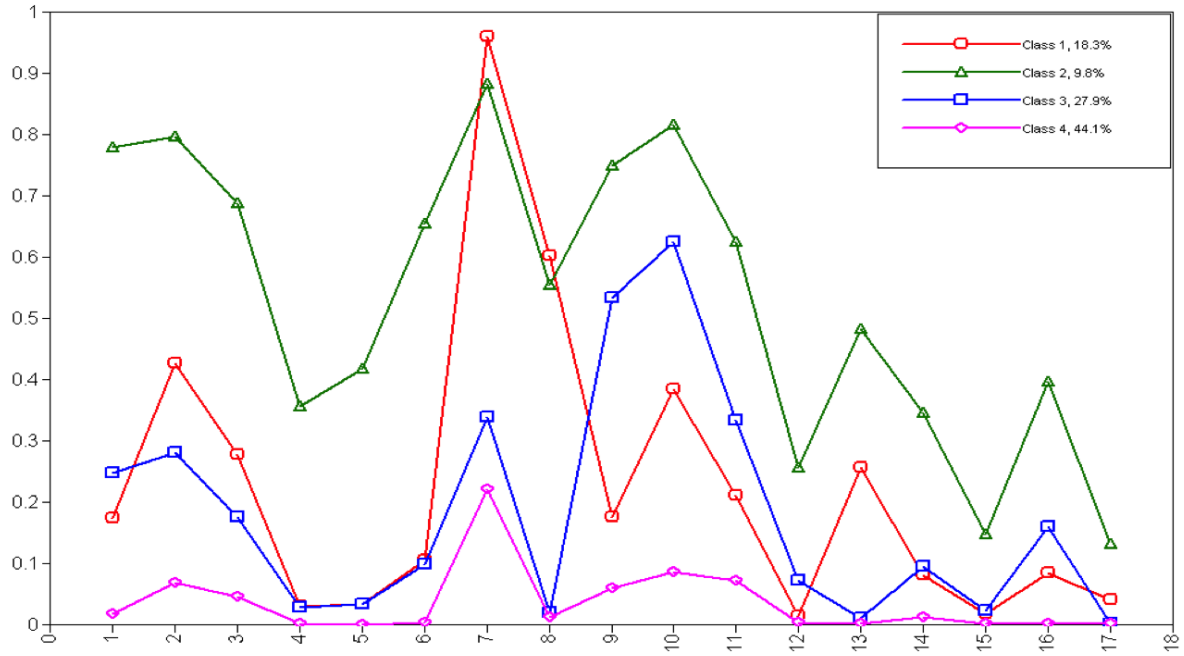
2. The "modal assignment" rule assigns people to the most likely class. What would be this person's modal asssignment? _____

3. Irma performed a latent class analysis that gave an entropy $R^2 = 0.122$. She then assigned respondents to classes. Subsequently, she performed a multinomial regression using the assigned class as the dependent variable and age, gender, and education as predictors. What could be the problem with this analysis, given that entropy R^2 was 0.122?

5 Covariates

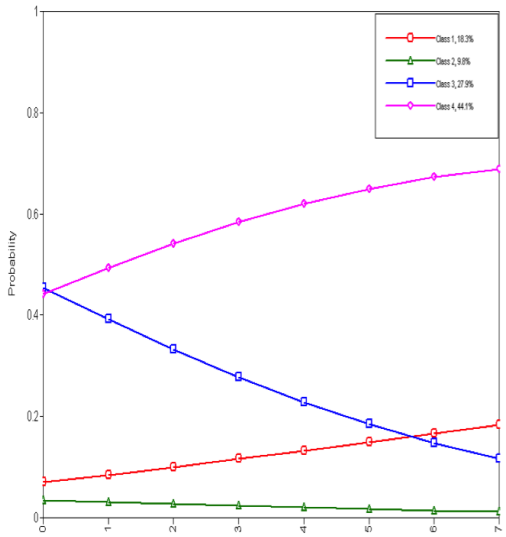
1. (from Nylund)

   Below is the profile plot (Mplus output) for a latent class analysis of 17 indicators of antisocial behavior. For each indicator, 0 means the antisocial behavior did not happen and 1 that it did.

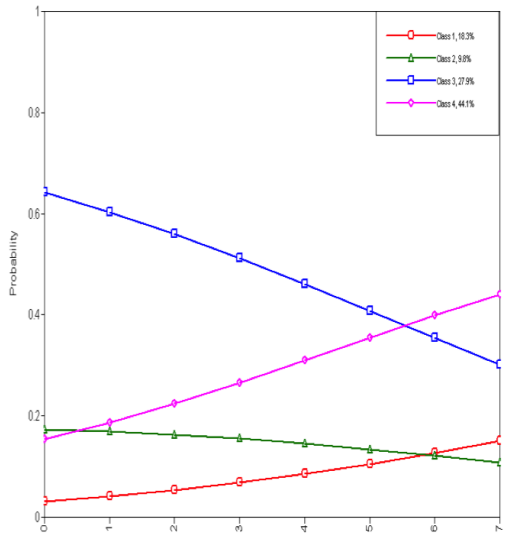


   Nylund regressed the latent class variable on gender and age category (1–7). The resulting Mplus plots are below.

Men



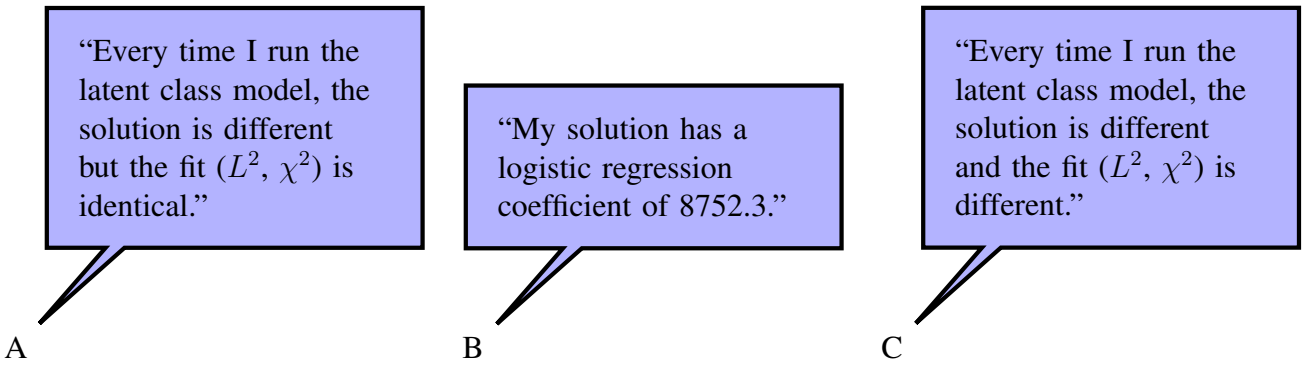
Women



   Give a substantive interpretation of the rearession of the latent class on gender and age. Include the meaning of the classes in your interpretation.

6 Vandamál og lausnir [Problems of LCM and solutions]

1. Which problems are described below?



Pick your answers out of the following:

I. Boundary solution
II. Local maxima
III. Non-identification

7 Finally

1. Do you think LCM could be useful for your own research? If so, how? If not, why not?

2. Did you learn anything that surprised you (what)?

3. How could the course be improved?

Þakka þér kærlega!
Thank you very much!