Three-Step Latent Transition Analysis

Bengt Muthén

Mplus
www.statmodel.com

bmuthen@statmodel.com

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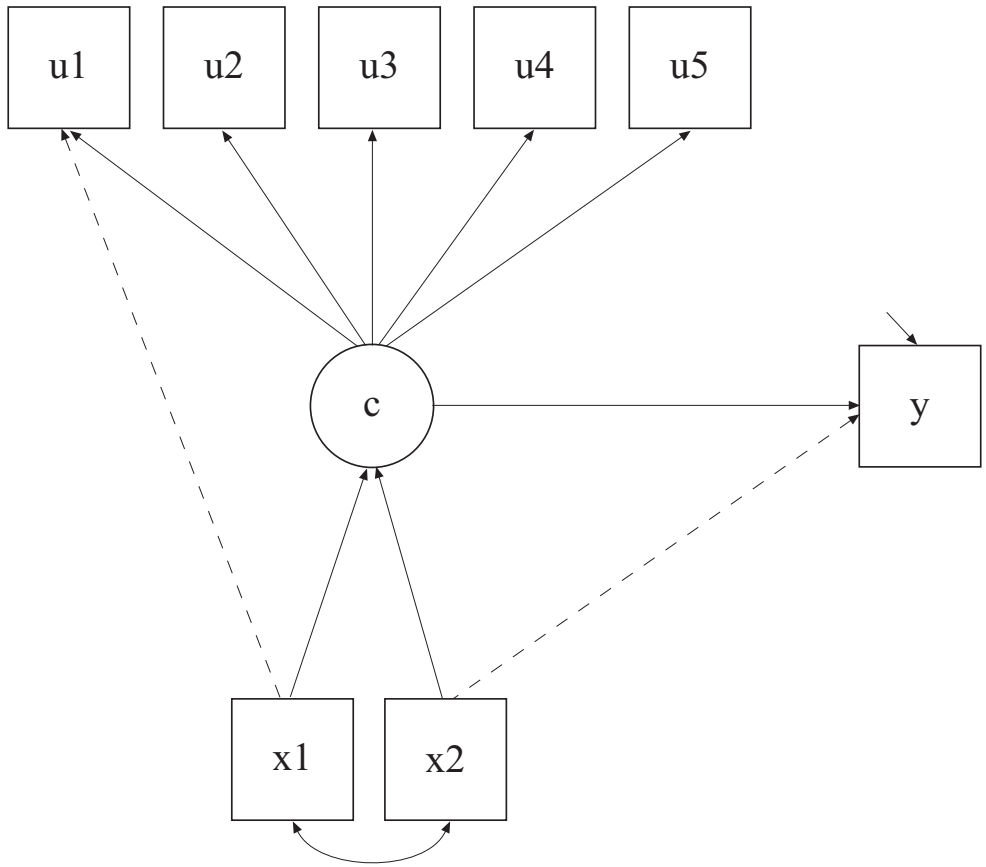
1-step analysis versus 3-step (analyze-classify-analyze) latent class analysis



Substantive Checking of Latent Class Models

- Latent class models should be subjected to both statistical and substantive checking (Muthén, 2003 in Psychological Methods)
- Substantive checking can be done by relating latent classes to antecedents and consequences (covariates and distal outcomes)
- The 3-step approach is a useful tool for this

The Old 3-Step Approach

1. Estimate the LCA model
2. Determine each subject's most likely class membership
3. Relate the most likely class variable to other variables

The old 3-step approach is problematic: Unless the classification is very good (high entropy), this gives biased estimates and biased standard errors for the relationships with other variables.

The LCA Provides Information About the Classification Quality

Average Latent Class Probabilities for Most Likely Class Membership (Row) by Latent Class (Column)

	1	2	3
1	0.839	0.066	0.095
2	0.053	0.845	0.102
3	0.125	0.107	0.768

The New 3-Step Approach

- New 3-Step approach correcting for classification error
  1. Estimate the LCA model
  2. Create a nominal most likely class variable N
  3. Use a mixture model for N, C and X, where N is a C indicator with measurement error rates prefixed at the misclassification rate of N estimated in the step 1 LCA analysis
- Bolck, Croon, & Hagenaars (2004) Estimating latent structure models with categorical variables: One-step versus three-step estimators. Political Analysis, 12, 3-27.
- Vermunt (2010). Latent Class Modeling with Covariates: Two improved three-step approaches. Political Analysis, 18, 450-469
- Asparouhov & Muthén (2012). Auxiliary variables in mixture modeling: A 3-step approach using Mplus. Mplus Web Note 15.

Classification Information from Step 1 LCA

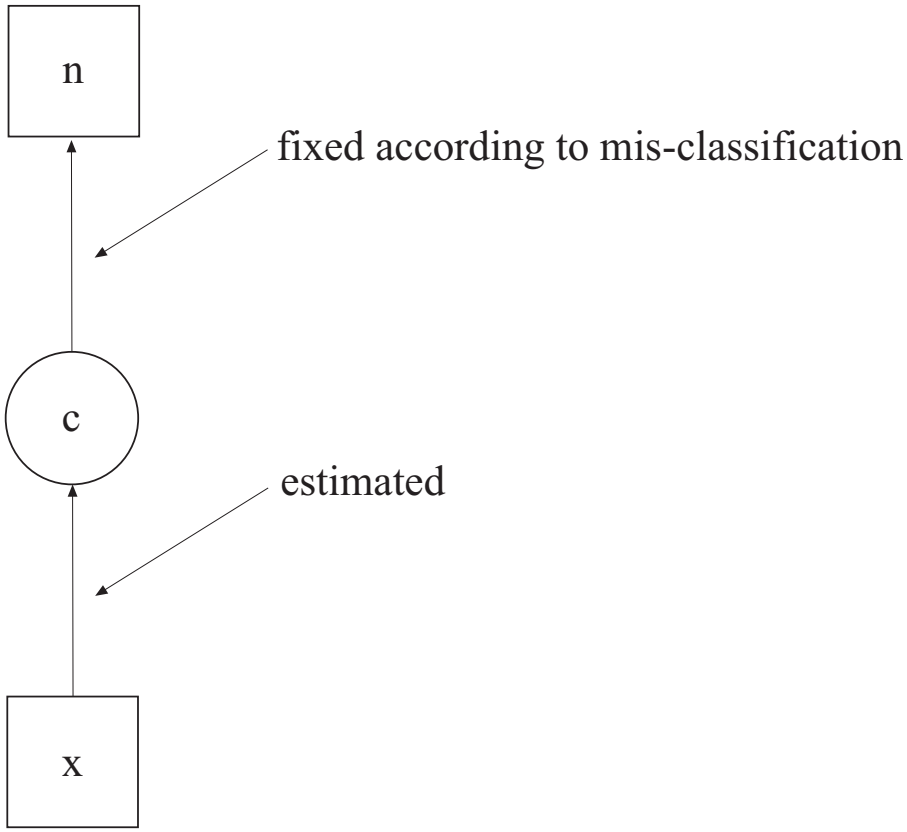
Average Latent Class Probabilities for Most Likely Class Membership (Row) by Latent Class (Column)

	1	2	3
1	0.839	0.066	0.095
2	0.053	0.845	0.102
3	0.125	0.107	0.768

log(0.839/0.095) = 2.178
log(0.066/0.095) = -0.364
log(0.053/0.102) = -0.654
log(0.845/0.102) = 2.114
log(0.125/0.768) = -1.815
log(0.107/0.768) = -1.970

Step 3 Regression on a Covariate

- n: Most likely class membership from Step 2 (nominal variable)
- c: Latent class variable
- x: Covariate



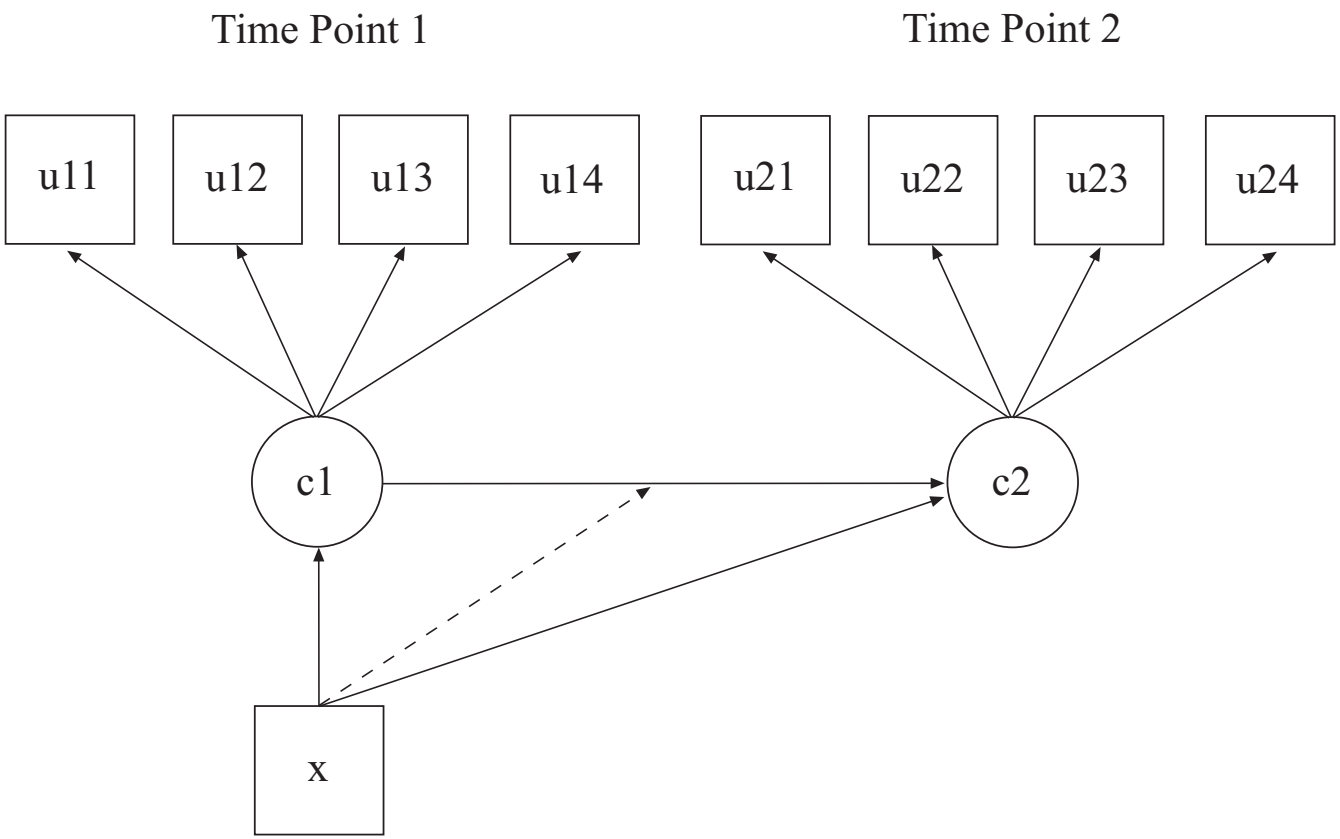
Mplus Input File for Step 3 in the 3-Step Estimation

```
VARIABLE:   NAMES = u1-u5 x p1-p3 n;
            USEVARIABLES = x n;
            CLASSES = c(3);
            NOMINAL = n;
DATA:       FILE = man3step2.dat;
ANALYSIS:   TYPE = MIXTURE; STARTS = 0;
MODEL:      %OVERALL%
            c ON x;
            %c#1%
            [n#1@2.178];
            [n#2@-0.364];
            %c#2%
            [n#1@-0.654];
            [n#2@2.114];
            %c#3%
            [n#1@-1.815];
```

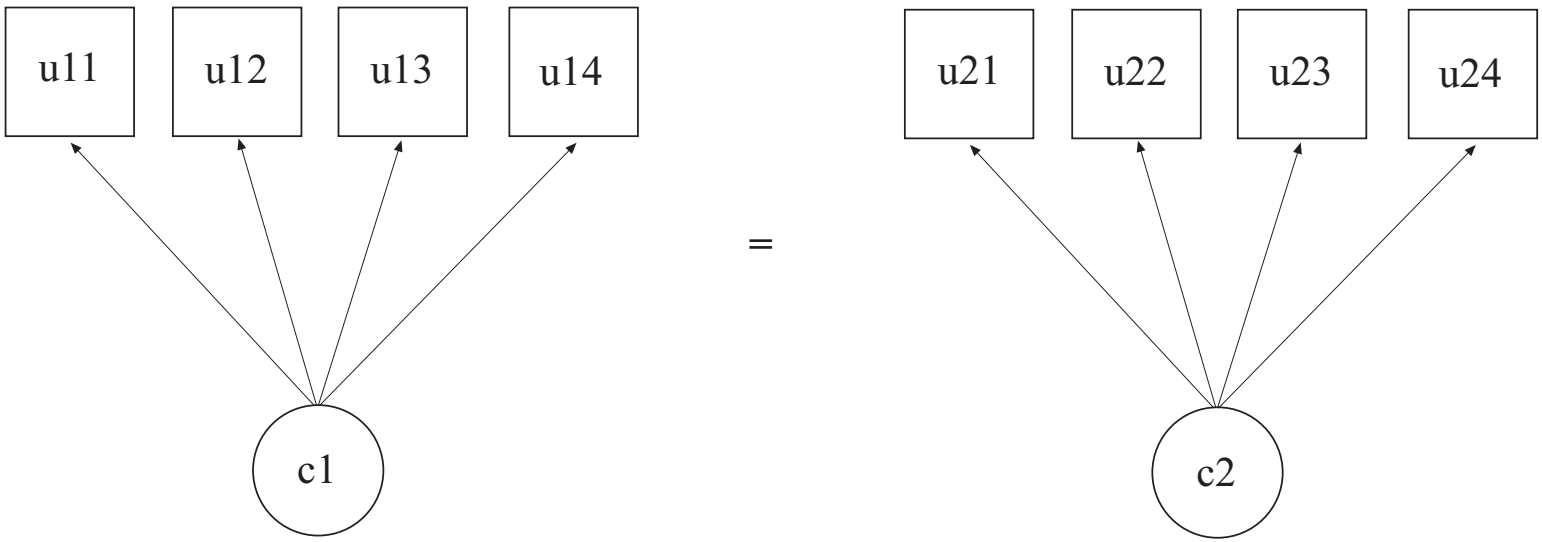
A Second Look at Distal 3-Step

- In some examples the Asparouhov-Muthén distal 3-step method in Mplus Web Note 15 leads to changes in latent class formation between Step 1 and Step 3 - warning given in Mplus Version 7.1
- Lanza et al. (2013) in the SEM journal propose a different distal 3-step method that avoids changes in class formation. Included in Mplus Version 7.1
- Future research needed to evaluate which method, including Most Likely Class and Pseudo-class, is least sensitive to violations of assumptions such as no direct effects

3-Step Latent Transition Analysis

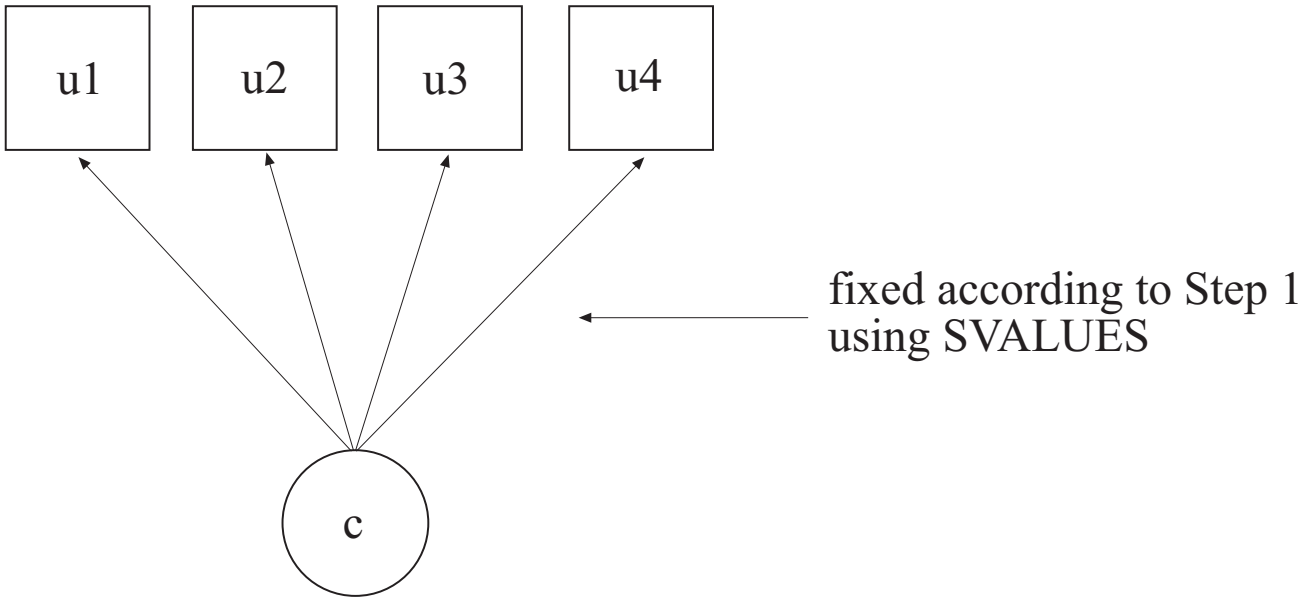


LTA: Step 1



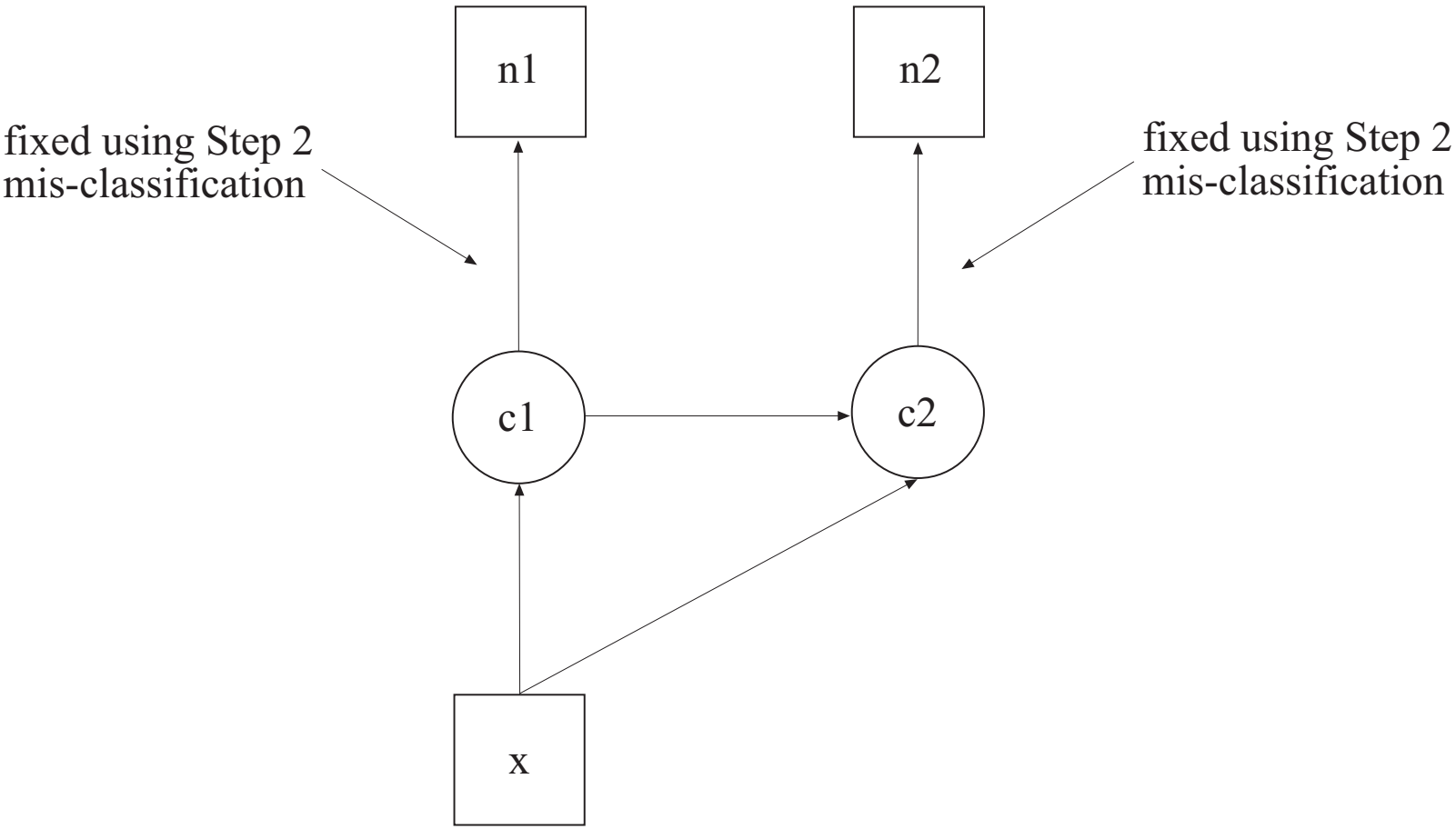
LTA: Step 2

For each time point:



Save most likely class

LTA: Step 3


n1
n2
fixed using Step 2
mis-classification
fixed using Step 2
mis-classification
c1
c2
x

3-Step Mover-Stayer LTA