LCA Examples

Lecture 13
10/16/06

Outline

Assumptions

$$L(\pi, p \mid Y) = \prod_{i=1}^{N} \left[\sum_{m=1}^{M} \pi_m \prod_{k=1}^{K} p_{km}^{y_{ik}} (1 - p_{km})^{(1-y_{ik})} \right]$$

- Independent individuals (product over i)
- Internal Homogeneity (p_{km})
- Conditional Independence (product over k)

Examples of latent class analysis

- "Identification of OCD-Related Subgroups Based on Comorbidity (2003) Nestadt, Addington, et al. Biological Psychiatry.
- "Explore whether or not there are underlying clinical constructs that distinguish OCD-related subgroups"

Subjects and Methods

- OCD cases (n=80), control subjects (n=73) and their respective first degree relatives
- 450 subjects had complete data on all 10 relevant diagnoses
  - OCD, OC-personality disorder, tic disorder (TD), panic disorder or agoraphobia (PD/AG), generalized anxiety disorder (GAD), separation anxiety disorder (SAD), recurrent major depressive disorder(RMDD), hypochondriasis or body dysmophic disorder (SOM), pathologic skin picking or nail biting (PSP/NB), anorexia nervosa or bulimia nervosa (ED)
  - Selected because of known association to OCD.
  - Some combined based on high redundancy
- Mplus used for model estimation
- Tried 2, 3, 4, 5 class models
- Based model choice on AIC and 'scientific' interpretation

	Minimal	RMDD/GAD	Highly Comorbid	OCD/PD/ AG/TD
Class Prevelence	0.73	0.2	0.03	0.03
Obsessive-Compulsive	0.03	0.54	0.93	0.6
Recurrent Major Depression	0.1	0.42	0.93	0.01
Gen Anxiety D/O	0.02	0.21	0.61	0.36
Panic/Agoraphobia	0.02	0.15	0.28	0.99
Tic D/O	0.02	0.07	0.01	0.34
Separation Anxiety	0.03	0.16	0.47	0.53
Obsessive-Compulsive Personality D/O	0.03	0.27	0.33	0.42
Hypoch/ Body Dysmorphic	0.02	0.01	0.99	0.18
Nail Biting/ Skin Picking	0.07	0.31	0.72	0.36
Eating D/O	0.02	0.06	0.2	0.01

Conclusion

- Best fitting model is four class structure. (1) Minimal disorder, (2) predominant RMDD and GAD, (3) "highly comorbid", (4) PD/AG and TD. First three classes are ordinal, and the 4th class is qualitatively distinct.

Comments

- Some classes SMALL
- Did investigate construct validity by assigning individuals to classes and comparing to other variables.
- Some items seem perhaps not so related to classes (i.e. 'bad items')
  - TD, OCPD, ED
- Correlated individuals (family study)

Confirm Existing Depression Diagnoses

Eaton WW, Dryman A, Sorenson A, McCutcheon A.
DSM-III major depressive disorder in the community. A latent class analysis of data from the NIMH epidemiologic catchment area programme.
Br J Psychiatry. 1989 Jul;155:48-54.

Purpose: To examine the DSM-III diagnostic criteria for major depression in two samples.

~90% of suicides in developed countries had a mental disorder at the time (Healthy People 2010 - SAMHSA)

ECA – The Sample

- 5 community mental health catchment areas
- Household epidemiological surveys
- Sample: Baltimore (3198)
- Symptoms 30 days prior to interview

Prevalence of Indicators in Baltimore

- Dysphoria – sad for 2 wks (4%)
- Appetite change – (6%)
- Sleep problems – (11%)
- Moving slowly or too much – (6%)
- Interest in sex – (2%)
- Tired out – (7%)
- Worthless – (3%)
- Concentration/Thinking (5%)
- Suicide – (9%)

Model Fit

Model	Chi-Square	DF	Class Prevalence A	B	C	D
Independence	2416	511	100			
Two class unrestricted	559	492	88	12		
Two class restricted (C)	1045	493	97	3		
Three class unrestricted	400	482	83	15	2	
Three class unrestricted (C)	436	483	86	12	1	
Three class restricted (BC)	995	485	97	2	1	
Four class unrestricted	376	474	82	14	2	2
Restricted (C)	385	473	82	15	1	2

Restrictions: (C) If a subject is in the depressed class, he must have dysphoria.
(BC) Dysphoria is required for either of the non-normal classes.

Model Selection

- Chi-Square Statistics used for comparing n+1 class model versus n class model
- For nested models, (I.e., when one model is a constrained version of another, you can take the difference in chi-square between the two models, and the df = difference in df between the two models.

A Look at Assignments

- Which symptom patterns get you into Class C (Major Depression)?
  - All patterns with dysphoria and 5 other symptoms were in class C and also would be considered Major Depression by DSM-III.
  - Certain patterns with dysphoria and only 4 other symptoms would be considered Depression by DSM-III but would not be in class C. All but one of these patterns includes sleep: sleep may not indicate serious depression
  - Certain patterns are in Class C but not DSM-III-all of these include concentration, suggesting it might be a more serious indicator of depression

Conclusions

- A three class model fits the observed data best, and the third class strongly resembles DSM-III Major Depression
- Certain symptoms may indicate either more or less serious depression based on the results of the latent class analysis: this might guide treatment
- Results were replicated in Raleigh-Durham, see paper for methods and details.

Latent Class Analysis of Lifetime Depressive Symptoms in the National Comorbidity Survey

Patrick F. Sullivan, M.D., F.R.A.N.Z.C.P.,
Ronald C. Kessler, Ph.D., and Kenneth S. Kendler, M.D.

(Am J Psychiatry 1998; 155:1398–1406)

- National Comorbidity Study
- N=2836 (excluded asymptomatic people)
- Used worst lifetime episode
  - At least two weeks
  - Impairment or help-seeking
  - One or more depression sx
- 6 class model with 14 indicators

TABLE 1. Class Membership (Total=2,836) and Endorsement Frequencies of the Variables in the Best-Fitting Latent Class Analysis (LCA) Solution Based on Data From the National Comorbidity Survey (NCS)[a]

Variable	Class 1: Severe Typical (N=332)	Class 2: Mild Typical (N=488)	Class 3: Severe Atypical (N=169)	Class 4: Mild Atypical (N=305)	Class 5: Intermediate (N=881)	Class 6: Minimal Symptoms (N=661)
Prevalence in the NCS (%)	4	6	2	4	11	8
Variables used in LCA (%)						
DSM-III-R A criteria for major depression						
Feelings of depression	98	85	95	80	82	90
Loss of interest	91	51	85	51	68	11
Appetite decrease	88	73	39	2	11	4
Appetite increase	11	4	83	74	0	2
Weight decrease	77	82	40	1	6	4
Weight increase	0	2	84	68	0	0
Insomnia	92	75	87	57	55	27
Hypersomnia	31	8	54	23	26	3
Psychomotor agitation	35	20	49	10	9	5
Psychomotor retardation	62	6	56	11	14	0
Tiredness/lack of energy	92	34	92	58	59	11
Feelings of guilt or worthlessness	84	29	83	34	39	16
Trouble concentrating	94	42	85	41	53	7
Thoughts of death/suicide	77	39	78	39	56	25
Female gender	71	74	65	68	50	50
DSM-III-R major depression (%)	98	63	100	63	52	1
Number of depressive symptoms (range: 1–14)						
Mean	9.3	5.5	10.1	5.5	4.8	2.0
SD	1.3	1.4	1.5	1.6	1.5	0.9

[a] Fifteen variables were entered into the LCA: 14 depressive symptoms that represented the nine "disaggregated" DSM-III-R A criteria for the lifetime worst episode plus gender. The best-fitting solution contained six classes.

Conditional Dependence

- Can motivate fitting of more classes than necessary
- Fix:
  - "joint" items (as in Eaton, 1989)
  - Polytomous indicators
  - Drop items (as in Netstadt, 2003)
  - Other methods being developed

Examine Subtypes in Different Groups

Castle DJ, Sham PC, Wessely S, Murray RM. The subtyping of schizophrenia in men and women: a latent class analysis.
Psychol Med. 1994 Feb;24(1):41-51.

Genetics Section, Institute of Psychiatry, London

Purpose: To examine the types and prevalences of schizophrenia in men and women

Camberwell Register

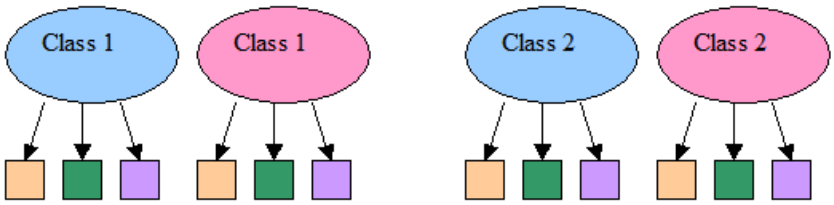
- Area of London south of the Thames
- 447 first contact patients with psychotic illness from 1965 to 1984

Simultaneous Latent Class Models

Forces some classes to be all male, or all female, by setting the starting conditional probabilities of being male to either 0 or 1.

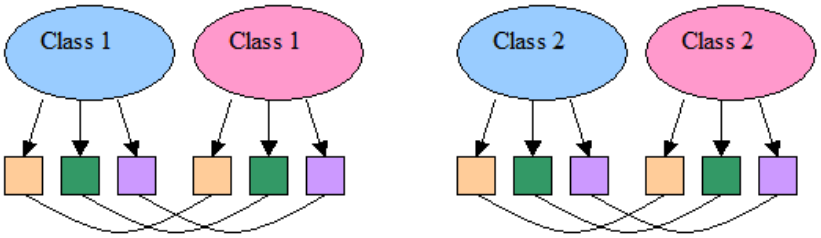
Can also force "homogeneity" – I.e., force male and female classes to have the same conditional probabilities, and then see how the fit compares to unconstrained models.

Non-Homogenous Models



How many parameters? (4-1)+(4*3)

Homogenous Models



How many parameters? (4-1)+(2*3)

Prevalence of Indicators

- Males (51%)
- Family History (8%)
- Restricted Affect (11%)
- Persecutory Delusion (77%)
- Poor Social Adjustment (37%)
- Dysphoria (48%)
- Early Onset (37%)
- Winter Birth (44%)

Model Fit

Model	Chi-Square	L-Square	df
M1. 1 Class per Gender, Total Homogeneity	465.18	325.85	247
M2. 1 Class per Gender Unconstrained	419.39	265.42	240
M3. 2 Classes per Gender, Total Homogeneity	264.18	222.99	238
M4. 2 Classes per Gender Unconstrained	250.41	176.96	225
M5. 3 Classes per Gender, Total Homogeneity	245.34	204.51	230
M6. 3 Classes per Gender Unconstrained	260.68	157.67	214

Parameter Estimates M4

	Males		Females	
	Class 1	Class 2	Class 3	Class 4
Prevalence	0.22	0.29	0.11	0.38
Family History	0.11	0.03	0.14	0.08
Restricted Affect	0.30	0.06	0.13	0.03
Persecutory Delusions	0.65	0.83	0.43	0.90
Social Adjustment	0.72	0.29	0.44	0.21
Dysphoria	0.50	0.34	0.56	0.55
Early Onset	0.78	0.20	1.00	0.08
Winter Birth	0.36	0.51	0.53	0.40

Parameter Estimates M5

	Class 1	Class 2	Class 3
Prevalence-Men	0.29	0.22	0.00
Prevalence-Women	0.13	0.23	0.13
Family History	0.10	0.07	0.01
Restricted Affect	0.22	0.03	0.00
Persecutory Delusions	0.61	0.88	0.93
Social Adjustment	0.60	0.20	0.23
Dysphoria	0.50	0.31	0.98
Early Onset	0.74	0.09	0.16
Winter Birth	0.41	0.51	0.28

Conclusions

- M5 is easier to interpret.
- Class 1 is characterized by + family history, early onset, restricted affect, poor social adjustment, and male:female ratio is 2:1
- Class 2 is characterized by persecutory delusions, winter birth, and similar prevalence in men and women.
- Class 3 is found predominantly in women, and is characterized by dysphoria, persecutory delusions.

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A latent class analysis of underage problem drinking: Evidence from a community sample of 16–20 year olds

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- 4056 subjects aged 16-20 from 212 communities
- Goal: identify subtypes of underage drinkers, in order to determine what characteristics indicate problem drinking
- Indicators – individual, peer, and family factors.

Choosing number of classes

- Comparison of median absolute % difference between observed and expected odds ratios between indicators. (15.7%, 6.6%, 3.6%)
- Examination of classification error (6%, 16%, 21%)
- AIC

	Class 1	Class 2	Class 3
class prevalence	0.43	0.3	0.27
Drank 6+ last month	.016 (.003)	.066 (.010)	.610 (.024)
Binge in last 2 wks	.110 (.011)	.350 (.032)	.977 (.003)
Drunk 2-3x/month	.118 (.013)	.518 (.028)	.960 (.011)
Drink and Drive	.030 (.007)	.064 (.016)	.342 (.020)
Passed Out	.032 (.004)	.509 (.037)	.638 (.017)
Hangover or HA	.226 (.023)	.802 (.025)	.791 (.016)
Social Consequences	.076 (.011)	.395 (.027)	.508 (.019)

Comments

- Good sample size
- Good selection of number of classes
- Calculation of standard errors that take into account clustering.
- Cross-sectional study – what would make this analysis even better?

Reliability and Validity in LCA

- Large samples sizes = multi-site, many interviewers
- Does replication of results speak to reliability or validity?
- How to establish validity of classes?
  - Internal construct validity
  - External construct validity
- How might latent classes be used to establish validity of a new scale?