Exam Statistics:



Use the following information to answer questions 1A-1G.

In 2006, Grant et al. published an article entitled "A comparison of the latent class structure of cannabis problems among adult men and women who have used cannabis repeatedly" in the journal *Addiction*. They found that results and class structure were similar for men and women and <u>we only</u> discuss the findings in the male sample here. The sample was drawn from the NLAES, a general population

sample of 42, 862 adults. <u>Respondents had to have used cannabis 12+ times to enter the diagnostic section</u> ('ever use' was not assessed). Seventeen per cent of the men (n=3112, mean age = 33.62 years) had done so, and were queried about specific behaviors associated with DSM-IV abuse and dependence.

Assume that the authors are trying to define the latent construct of cannabis abuse and dependence. Eleven items of abuse and dependence of cannibis were used in this latent class analysis. Item names and their sample prevalences in the sample are shown in the table below.

	(n=3112)
Abuse symptoms	
Social problems stemming from use	0.26
Hazardous use	0.53
Role interference	0.22
Dependence symptoms	
Use despite health problems	0.07
Use despite emotional problems	0.11
Giving up activities	0.08
Spending a lot of time	0.12
Unable to quit	0.08
Using more	0.13
Withdrawal	0.18
Tolerance	0.22

Mplus was used for model estimation. A 4 class model was found to be most appropriate based on the BIC for classes with 2, 3, 4, and 5 classes. The estimated item prevalences for the four classes are shown graphically on the plot to the right and estimated class



Initials

sizes are shown below the plot in the legend.

1A. (5 points) To what population can we generalize these results (1 sentence or less)?

Men who have used cannabis twelve or more times.

1B. (5 points) What proportion of the sample is predicted to be in the severe dependence/abuse class?

6%

1C. (5 points) Which two items most clearly distinguish the unaffected class from the hazardous use class?

"Hazardous use" and "role interference"

1D. (10 points) For the unaffected and the hazardous use classes, several predicted item prevalences are reported as 0. Why might some readers who are familiar with latent class analysis and its estimation be concerned about reported item prevalence estimates of 0? Specifically, what questions does it raise about model estimation? (2 sentences)

When I see symptom prevalences within classes of 0 or 1 it makes me think that maybe the model did not converge to the appropriate solution. This is a common problem when the sample size is too small to be able to extract the number of classes desired and we may worry that we have a problem of "estimability" or "identifiability" of this model.

1E. (5 points) A critic of the paper thinks that cannabis use and dependence should be measured as a unidimensional continuous construct. This critic suggests simply using the number of reported items as a measure of cannabis abuse and dependence. If one of the goals of the latent class model is diagnosis, what drawback does his SCALE have versus the CLASS representation (2 or fewer sentences)?

Scales tend to provide continuous representations of constructs and do not provide any information about what appropriate "cut-offs" might be for diagnostic categories.

1F. (10 points). The critic also was wary of the number of classes in the selected model. He says he would like to know what the p-values are for likelihood ratio tests comparing the 4 class model to the 3 class and 5 class models. Can you provide TWO reasons why the likelihood ratio test is probably not appropriate for model choice here? (2 or fewer) sentences)

1. the "nested" assumption that is required for performing a likelihood ratio test is not clearly met.

2. the likelihood ratio test is highly dependent on the sample size

3. the likelihood ratio test makes the assumption that cell counts are large (i.e., at least five). It is unlikely that this assumption is met here.

Audrain-McGovern et al. published an article "The Impact of Self-Control Indices on Peer Smoking and Adolescent Smoking Progression" in the Journal of Pediatric Psychology in 2006. Their objective was to determine the direct impact of self-control variables on baseline smoking and smoking progression and determine whether self-control had indirect effects on smoking practices through effects on peer smoking. Study participants were 918 adolescents who were followed from 9th through the 12th grade and completed self-report measures of peer smoking, self-control, and cigarette smoking. An exploratory factor analysis (EFA) was conducted to assess the factor structure of a 41-item self-control measure.

We will discuss only the results of the factor analysis for questions 2A-2D. An oblique rotation was used and examination of eigenvalues suggested a six-factor solution. The results are shown on the next page

2A. (5 points) The communality for "easily calms down" is 0.62. Explain in one sentence what this means.

62% of the variation in the item "easily calms down" is explained by the other items (or, alternatively, by the factor structure).

2B. (5 points) The factor loading for "easily calms down" on factor 5 ("conscientiousness") is 0.67. Explain in one sentence what this means.

It is approximately the correlation between factor 5 and the item "easily calms down" is 0.67 (approximate because rotation used was oblique: those who didn't acknowledge oblique rotation also got full credit).

2C. (5 points) The sum of the eigenvalues for the 6 factor model is 24.8. What percentage of variation in the data is explained by the 6 factor model?

To get the percent variation explained, we take the sum of the eigenvalues and divide it by the number of items. 24.8/41 = 60%

2D. (5 points) While this model appears promising, it has been suggested that there are too many questions in this survey to be practical in some settings. If you had to remove items, how would you choose which ones to remove? In this model specifically, which item would you say is LEAST helpful and could be removed?

I would look at the communalities to decide and remove items with low communalities. In this example, I would remove "has a lot of accidents" because its communality is only 0.39, which is the lowest of all the items.

Table II. Factor Loadings from the Exploratory Factor Analysis of Self-Control									
Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Communality		
Easily calms down					0.67		.62		
Gets annoyed					0.57		.66		
Count on me					0.51		.66		
Plans ahead					0.45		.50		
Waits patiently					0.63		.50		
Sticks with things					0.65		.65		
Thinks before acts					0.63		.59		
Concentrates on one thing					0.54		.57		
Sits still in class					0.57		.54		
Gets information		0.63					.47		
Thinks hard about what steps		0.76					.60		
Thinks of choices		0.82					.71		
Different ways to take care of it		0.83					.70		
Thinks different solutions		0.60					.68		
Tries to solve problem		0.73					.58		
Makes action plan		0.75					.61		
Stops and thinks		0.69					.57		
Jumps before gets answer	0.52						.50		
Has everything right away			0.5				.60		
Has a lot of accidents	0.55						.39		
Reminded several times				0.71			.57		
Difficult to do work				0.74			.72		
Easily distracted				0.77			.72		
Switches between things				0.63			.59		
Gets frustrated				0.68			.59		
Bothers other students	0.58						.48		
Does not stop to think	0.75						.65		
Impulsive person	0.73						.61		
Talks quickly	0.76						.63		
Involved but wants out	0.68						.54		
Needs to use lots of self-control	0.72						.65		
Trouble because does not think	0.77						.73		
Gets carried away	0.72						.61		
Gets mad			0.76				.68		
Takes it out on someone else			0.79				.73		
Blames others			0.71				.68		
Throws things						0.72	.64		
Causes trouble						0.79	.73		
Does something exciting and risky						0.67	.57		
Hits someone						0.73	.67		
Yells and screams			0.7				.66		
Eigenvalues	12.22	6.34	2.32	1.42	1.32	1.18			
Cronbach's coefficient α	.88	.90	.80	.81	.78	.80			

Factor 1, impulsive control; Factor 2, planning; Factor 3, hostile blanning; Factor 4, attentional disregulation; Factor 5, conscientiousness; Factor 6, physical aggression.

Deirdre* tells you that from a pilot study of a home assessment of dementia (*this is a real person and a real study, FYI*), the observed correlation between scales A and B is 0.6. Scale A is a 14-item scale of depression and has a reliability of 0.65 and scale B is 5-item scale of behavioral problems (rummaging, resistance to care, etc) and has a reliability of 0.75.

3A. (5 points) What would you expect the true correlation between these two scales to be? (*Please show all work*)

$$R_{T_xT_y} = \frac{r_{xy}}{\sqrt{r_{xx}r_{yy}}} = \frac{observed_correlation}{\sqrt{reliability_A \times reliability_b}} = \frac{.6}{\sqrt{.65 \times .75}} = 0.8593$$

1 pt for right equation 1 pt for each of the three values (.6, .65, .75) being in the right place 1 pt for the answer

3B. (5 points) She is trying to limit the length of the interview, and had determined that she has time for one more question. In order to maximize the observed correlation between the two scale scores, should she add an additional item to scale A, or scale B? (*Please show all work.*)

I graded this a bit strictly - I really wanted people to demonstrate on understanding of the correction of attenuation equation by actually showing all work (including the predicted observed correlation in each of the two scenarios. If some reference to respective changes to R was made, with a mention of how the observed correlation would be calculated, 1 of the 2 points was given.

Predicted reliability
with one item added
(use Spearman-
Brown) (1 pt each)
Predicted observed
correlation be A and B
$$Scale A \qquad Scale B
R_{A15} = \frac{N \times R_{A14}}{1 + (1 - N)R_{A14}} \qquad R_{B6} = \frac{N \times R_{B5}}{1 + (1 - N)R_{B5}}
R_{A15} = \frac{\left(\frac{15}{14}\right) \times .65}{1 + \left[\left(1 - \frac{15}{14}\right) \times .65\right]} \qquad R_{B6} = \frac{\left(\frac{6}{5}\right) \times .75}{1 + \left[\left(1 - \frac{6}{5}\right) \times .75\right]}
R_{A15} = 0.6655 \qquad R_{B6} = 0.7826$$
Predicted observed
correlation for attenuation formula for r_{xy}

$$R_{T_xT_y} = \frac{r_{xy}}{\sqrt{r_{xx}r_{yy}}}
r_{xy} = R_{T_xT_y} \times \sqrt{r_{xx}r_{yy}}$$

(1 pt each)

$$r_{x+1,y} = 0.8593 \times \sqrt{0.6655 \times 0.75}$$

 $r_{x,y+} = 0.8593 \times \sqrt{0.65 \times 0.7826}$
 $r_{x+1,y} = .60708$
 $r_{x,y+} = .61287$
(1 pt)
Correct decision: item should be added to B

The questions 4A-4E is taken from the paper:

Theunissen NCM, Vogels TGC, Koopman HM, Verrips GHW, Zwinderman KAH, Verloove-Vanhorick SP, Wit JM (1998) The proxy problem: child report versus parent report in health related quality of life research. *Quality of Life Research* (7):387-397.

This Dutch study enrolled 1,105 parent –child dyads in order to examine the validity of a new scale (TACQOL) of childrens' health-related quality of life. The scale consisted of 7 domains.

Below are values from the authors' MTMM analysis, though we have included only the first 4 scales (there were 7 total). Assume that "Child Responses" and "Parent Responses" represent two different methods.

Child Responses			Parent Responses						
		Physical complaints	Motor Function	Autonomy	Cognitive Functioning	Physical complaints	Motor Function	Autonomy	Cognitive Functioning
Child Responses	Physical complaints	-							
	Motor Function	0.47	-						
	Autonomy	0.32	0.61	-					
	Cognitive Functioning	0.39	0.46	0.38	-				
Parent Responses	Physical complaints	0.61	0.29	0.23	0.25	-			
	Motor Function	0.24	0.50	0.38	0.24	0.36	-		
	Autonomy	0.18	0.48	0.48	0.20	0.26	0.55	-	
	Cognitive Functioning	0.23	0.14	0.14	0.61	0.27	0.31	0.28	-

4A. (5 points) In the table, there are a number of boxes with dashes (-) in them. What values belong in those boxes, and how would the study authors have obtained those values from their study?

(2pts) These are the reliability diagonals (MonoTrait MonoMethod is also acceptable). (3pts) Ways to get this from study include test-retest, cronbach's alpha/split half, or ICC. Full credit for listing at least 1 reasonable method. 4B. (5 points) Please draw a square around all the correlations in the "validity diagonal". What type of validity do these values speak to? These are the darkest gray squares.

(2pts) for correct identification

(3pts) for convergent validity. 1 out of three points for "construct validity", which is too general.

4C. (5 points) Please draw a triangle around all correlations that are HeteroTrait MonoMethod.

These are the lightest gray squares.

4D. (5 points) Please draw a circle around all correlations that are HeteroTrait HeteroMethod.

These are the medium gray squares.

4E. (10 points) Based on the available information so far, do you think the TAQCOL displays good convergent validity? Identify which values (Mono or Hetero Trait, Mono or Hetero method) you are using, and why those values support your opinion. (4 sentences)

(2pts) for decision – a number of reasonable responses were OK here – could say good, saying that with the large sample size, all of the validity values were almost certainly statistically significantly greater than 0. Also, they were of decent size. Though, it might also be reasonable to say that .48 is not that great. It is also reasonable to say that it's still a question mark since we are missing the reliability values.

(2pts) identification of validity diagonal or MonoTrait HeteroMethod as the relevant values.

(3pts) A correct answer needed to say that the validity values had to be significantly greater than 0, large enough to warrant further investigation. If this was said, but it wasn't said that they had to be significantly greater than 0, credit was still given for that point, because it would have been implied (particularly with such a large sample size) Netermeyer says "large relative to the other correlations in the matrix", so this is also acceptable, though in this case, it was necessary to explicitly say "sig. higher than 0". As an aside, this (Netermeyer) differs in a subtle way from the original Campbell and Fiske article (and other sources) – and I think it blurs the line between convergent and discriminant validity. For more information, look at the MTMM link on the course website, or check out this article by Dielman & Wilson (1970) Convergent and Discriminant Validity of Three Measures of Ability, Aspiration-Level, Achievement, Adjustment and Dominance. (Available on JSTOR) (3pts) Basically here (in keeping with the spirit of the question) I wanted people to show good discrimination between those values (or criteria) which speak to convergent validity, and those that speak to discriminant validity. If one simply listed all the criteria associated with evaluating MTMM, it doesn't demonstrate a full understanding of what's going on. So, you got credit for NOT mentioning criteria that speak to discriminant validity.

NOT saying the MTHM (validity) values had to be greater than the HTHM values in the same row and column in its hetermethod block. NOT saying a validity coefficient should be higher than all coefficients in the heterotrait-monomethod triangles. (Or referencing that trait effect had to be higher than the methods effect)

NOT saying The same pattern of trait interrelationship should be seen in all triangles.

.The End