1. Duane Alwin addresses the issue of the relation between the number of response categories used in survey questions and the quality of measurement in an article entitled "Feeling Thermometers Versus 7-Point Scales: Which Are Better?" (1997, *Sociological Methods and Research* 25:318-340). He sets up the following two competing hypotheses:

i. Given two survey questions that assess the same construct, a question with more than 7 response categories will have ***lower*** reliability than a question with 7 response categories. Seven response categories is about the limit to the number of response categories that people can handle, according to this hypothesis, and the introduction of more response categories will only add noise (and hence lower reliability) to the measure.

ii. Given two survey questions that assess the same construct, a question with more than 7 response categories will have ***higher*** reliability than a question with 7 response categories. According to this hypothesis, more categories provide the opportunity for respondents to provide more information, and higher levels of information in the data will lead to higher levels of reliability.

To test these competing hypotheses, both a single survey question with 7 *response categories* and a single survey question with 11 *response categories* were used to assess satisfaction with a variety of domains, including satisfaction with respondent's friends. For the survey question with 7 response categories the reliability of the friends satisfaction measure was 0.533. For the survey question with 11 response categories the reliability of the friends' measure was 0.673.

1a. (6 points) Does the above information better support hypothesis (i) or hypothesis (ii)? Why?

1b. (8 points) What would be the value of Cronbach's alpha for a scale of "satisfaction with friends" that consisted of 10 items that had the reliability of the "friends satisfaction" item that had 7 response categories? Be sure to show your work, and report your answer to three decimal places.

1c. (8 points) How many items would be required to create a scale of "satisfaction with friends" that had the same reliability as the scale in 1b, but consisted of items that had the reliability of the "friends satisfaction" item that had 11 response categories? Be sure to show your work, and for your final answer round any fraction up (e.g. if the final result of your calculations is 8.1, then report an answer of 9).

1d. (8 points) You are writing a grant proposal to investigate in detail the association of depression and satisfaction with friends. You will use a depression scale that you expect will have a reliability of about 0.7 in the population you are studying. The true correlation between depression and satisfaction with friends is 0.4. How many 11-response category items would be required for an expected correlation of 0.33 between the depression scale and the scale for satisfaction with friends? Be sure to show your work, and for your final answer round any fraction up (e.g. if the final result of your calculations is 8.1, then report an answer of 9).

2. The following questions refer to results from the article by Widyanto and McMurran entitled "The Psychometric Properties of the Internet Addiction Test," which appeared in the journal *CyberPsychology & Behavior* in 2004 (volume 7, pages 443-450). The study focuses on a factor analysis of a 20-item test for the hypothesized construct of internet addiction. The pilot sample consist of 86 people, and all 20 items had 5 response categories. The following page reports main results from the study. Note that the eigenvalues are based on a principal components analysis before rotation.

Table 2. Rotated Component Matrix

Question	*How often . . .*	*1*	*2*	*3*	*4*	*5*	*6*
Q19	Do you choose to spend more time online over going out with others?	0.71					
Q13	Do you snap, yell, or act annoyed if someone bothers you while you are online?	0.62					
Q12	Do you fear that life without the Internet would be boring, empty and joyless?	0.60					
Q15	Do you feel preoccupied with the Internet when off-line or fantasise about being online?	0.56					
Q10	Do you block disturbing thoughts about your life with soothing thoughts of the Internet?	0.55					
Q2	Do you neglect household chores to spend more time online?		0.78				
Q14	Do you lose sleep due to late night log-ins?		0.65				
Q20	Do you feel depressed, moody, or nervous when you are offline, which goes away once you are back online?		0.63				
Q1	Do you find that you stay online longer than you intended?		0.60				
Q18	Do you try to hide how long you've been online?		0.40				
Q6	Does your work suffer (e.g., postponing things, not meeting deadlines, etc.) because of the amount of time you spend online?			0.85			
Q8	Does your job performance or productivity suffer because of the Internet?			0.83			
Q9	Do you become defensive or secretive when anyone asks you what you do online?			0.64			
Q11	Do you find yourself anticipating when you go online again?				0.74		
Q7	Do you check your E-mail before something else that you need to do?				0.71		
Q17	Do you try to cut down the amount of time you spend online and fail?					0.87	
Q5	Do others in your life complain to you about the amount of time you spend online?					0.67	
Q16	Do you find yourself saying "Just a few more minutes" when online?					0.61	
Q4	Do you form new relationships with fellow online users?						0.81
Q3	Do you prefer excitement of the Internet to intimacy with your partner?						0.65
Cronbach's standardized alpha		0.82	0.77	0.75	0.61	0.76	0.54
Eigenvalue		7.17	1.8	1.3	1.2	1.11	1.04
Percentage of variance explained		35.8	9.02	6.51	6.02	5.55	5.21

F1—Salience
F2—Excessive use
F3—Neglect work
F4—Anticipation
F5—Lack of control
F6—Neglect social life

2a. (5 points) What is the p:r ratio for this analysis?

2b. (5 points) If the communality of the items is 'wide' (that is, if it ranges between 0.2 and 0.8 across the items), is the sample size large enough to ensure good recovery of the latent underlying factors? Justify your answer in one or two sentences.

2c. (5 points) What additional information from the factor analysis should be added to Table 2 so that it would be possible to calculate the communality of each item?

2d. (5 points) Can you assess the discriminant validity of the individual items in Table 2? Why or why not?

2e. (5 points) One potential critique of this study is that it is too short and does not include a full assessment of the ways in which excessive internet use may have a negative effect on individuals. This critique refers to which type of validity? What would be a good response to this critique (please limit your answer to three or four sentences)?

2f. (5 points) Why would criterion validity not be appropriate to assess the validity of the internet addiction scale?

2g. (5 points) In order to assess the external validity of “excessive use” scale , what would be two strategic outcomes to measure? Explain how levels of association between the internet addiction scale and the two outcomes you list would help in the evaluation of external validity.

2h. (5 points) Sketch by hand a screeplot of the six eigenvalues provided. The authors chose to extract six factors -- does the interpretation of the screeplot also imply that six factors should be extracted? Why or why not?

2i. (5 points) 68.1% of the variance in the data is explained by this factor model with six factors. If an oblique rotation were now applied to the loading matrix, would you expect the percent variance explained to increase, decrease, or stay the same? Why (in one sentence)?

3. An article was recently published where the authors were interested in defining latent classes of Alzheimer's disease (Moran M, Walsh C, Lynch A, Coen RF, Coakley D, Lawlor BA. Syndromes of behavioural and psychological symptoms in mild Alzheimer's disease. Int J Geriatr Psychiatry. 2004 Apr;19(4):359-64). Based on a sample of size **240**, they estimated models with five and fewer classes and chose the three-class model as their best model. The estimated three class model is shown below.

		Class 1	Class 2	Class 3
Symptoms:	Delusions	0.18	0.59	0.41
	Hallucinations	0.06	0.09	0.15
	Aggression	0.00	0.32	1.00
	Agitation	0.14	0.57	0.41
	Diurnal rhythm disturbance	0.09	0.37	0.41
	Affective disturbance	0.24	0.62	0.45
	Anxiety	0.32	0.91	0.00
Class sizes		0.47	0.45	0.08

3a. (5 points) How many different symptom response patterns are possible given that there are seven symptoms and each is measured using a binary (i.e., yes or no) indicator?

3b. (10 points) A critic of the model said she was concerned about the identifiability of the model. Describe in four or fewer sentences what she meant by "identifiability" and, based on the information provided, what might lead her to worry about it.

3c. (10 points) The authors used the following justification for choosing the three-class solution:
"Five models were fitted, from one to five classes. The goodness of fit statistics suggested that the model with three classes had the best fit (see Table 2). A dramatic reduction in the Chi-Square statistic is observed as the number of classes increases from 1 and 2 to 3. The reduction in this statistic from 3 to 4 classes and from 4 to 5 is less marked. With this model [i.e, the 3 class model] 95.4% of the sample were correctly classified."

The table below was derived using information provided by the authors. Use the information in the table to help choose a "best" model and justify why you think it is the best model using information provided in the table in three or fewer sentences.

Number of classes	number of parameters in model (s)	-2 log-likelihood statistic	AIC	BIC	p-value for goodness of fit test
1	7	210.0	224.0	248.4	<0.0001
2	15	123.2	153.2	205.4	0.24
3	23	111.5	157.5	237.6	0.31
4	31	107.0	169.3	276.9	0.15
5	38	85.3	163.3	299.0	0.47