Homework 3
Due **Tues, June 13, 10 am**

1. This problem uses the social exchanges data set used in HW 2, http://web.pdx.edu/~newsomj/data.htm.

a. Obtain descriptive information from SPSS or R about the skew and kurtosis of all six variables (`company, include, social, unwant, doubt, meddle`). Report your findings and evaluate the degree to which the data may violate distributional assumptions based on criteria provided by West, Finch, and Curran (1995) for these univariate statistics. [Optionally, you can compute the normalized Mardia's coefficient using DeCarlo's macro with SPSS or the MVN package in R with `mvn(data = dataframename, mvnTest = "mardia")` and interpret in terms of the Bentler & Wu (2002) standard].

b. Using maximum likelihood with scaled chi-square and robust standard errors (`estimator=MLM` in Mplus or `estimator="mlm"` in lavaan), test the same two-factor model as in HW 2 Problem 1c. Report your findings, including information about model fit and standardized loadings. Compare your output to that obtained with the standard ML solution from HW2, and describe any differences in the fit statistics, the loadings, and the standard errors.

c. Show how the scaling correction factor was obtained, and explain what it tells you about nonnormality and the chi-square test.

2. Use the same data set that you used for Problem 2 in HW 2 (your own data set). Retest whichever model fit better from 2a and 2b using using maximum likelihood with scaled chi-square and robust standard errors (`estimator=MLM` in Mplus or `estimator="mlm"` in lavaan). Report your findings, including information about model fit and standardized loadings. Then, compare your output to that obtained with the standard ML solution. Be sure to describe any differences in the fit statistics, the loadings, and the standard errors.

3. For the following question, I have created another version of the social exchanges data set (socdep2) that includes a grouping variable (married) to indicate whether the participant was married or not (0 = not married, 1 = married). The data page has a new raw data file, new Mplus and lavaan input files, and SPSS version of the file (http://web.pdx.edu/~newsomj/data.htm). Be sure to use the correct input file and add the appropriate model statements for the problem. Include your output and show your work for any hand computations. For this problem, use the same data set and standard ML estimation (to simplify chi-square difference testing for now)[1]. For the models below, use factor variance identification rather than referent item identification.

a. Run two multigroup structural equation models (in Mplus or lavaan) to compare the two-factor CFA for unmarried and married to see if there is at least weak measurement invariance across groups (to simplify things, we are not comparing means or intercepts across groups in this exercise). In the first model, allow all parameters to differ across groups (same form model). In a second model, constrain only the loadings to be equal across marital groups, leaving factor variances, measurement variances, and correlations between the factors to be freely estimated in each group (partial or weak invariance). Report and interpret your findings, including the chi-square difference test.

b. Compare a predictive model across the marital groups using only the negative social exchanges factor (`unwant, doubt, meddle`) as a predictor of depression (`dep`). Test two models, one with the predictive path set equal across groups and one in which it is allowed to be freely estimated in the two groups. For both models, use equality constraints on all of the loadings. Report and interpret your findings.

4. The data for the following problems come from the same study, but another set of variables have been saved in a new data set (`healthdep2.sav` and `healthdep2.dat`). There are three waves of responses to the self-reported health question ("In general, would you say your health is excellent, very good, good, fair, or poor?"), called `health1`, `health2`, and `health3`, three waves of scores on the Center for Epidemiologic Studies-Depression (CES-D) scale (`dep1, dep2, dep3`), and positive social support (`possup1, possup2, possup3`). Age at Time 1 is also included. Higher scores indicate better health, more depression, and more

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[1] Analyses using the Satorra-Bentler correction for nonnormality did not lead to any differences in the substantive conclusions, although in actual practice it would likely be preferable to use this method. We will use regular ML here to make life easier for you.

support. Missing data are included (defined missing value code is -99), so use MLR estimation to account for nonnormality and missing data.[2]

a. Use a cross-lagged panel model to investigate the causal directionality of the relationship (whether higher depression leads to poorer health or better health leads to lower depression). Use only the first and third waves (i.e., `health1, dep1, health3, dep3`). Report and interpret your results.

b. Using the same data set, test a latent growth curve model using the positive support variable for all three waves (use the 0, 1, 2 coding for the growth factor). Show how the degrees of freedom are derived for this model. Describe and interpret your results from the model. Be sure to answer the following questions: Is there an overall increase or decrease in depression over time? Do the intercepts or slopes vary significantly across respondents? Do the intercepts and slopes *covary* across respondents? Draw a quick sketch by hand that depicts the slopes.

c. Use age at Time 1 to predict the intercepts and slopes of positive support. Hint: the minimum value of age in this data set is 65. Describe and interpret your results.

5. Draw the following model, which is described in "all-y" format. (* indicates parameter is free to be estimated, 1 or 0 indicates a fixed value, and all others are assumed to be zero). Label the parameters with the correct Greek notation. Hand drawn is acceptable, but this is a good opportunity to try drawing the model with PowerPoint or another graphic design software program.

Λ

	ETA 1	ETA 2	ETA 3	ETA 4
y1	*			
y2	*			
y3	*			
y4		*		
y5		*		
y6		*		
y7		*		
y8		*		
y9			1	
y10				*
y11				*
y12				*

Ψ

	ETA 1	ETA 2	ETA 3	ETA 4
ETA 1	1			
ETA 2	*	1		
ETA 3			*	
ETA 4				*

B

	ETA 1	ETA 2	ETA 3	ETA 4
ETA 1				
ETA 2				
ETA 3	*	*		
ETA 4			*	

$\Theta\varepsilon$

	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11	y12
y1	*											
y2		*										
y3			*									
y4				*								
y5					*							
y6					*	*						
y7					*		*					
y8								*				
y9									0			
y10										*		
y11											*	
y12												*

[2] With attrition, the MAR assumption deserves additional consideration, but is likely a reasonable or more reasonable approach than listwise deletion. To keep the HW burden down, we will forego any analyses of the missing data patterns or potential mechanisms in this assignment.