PSQF 6249 HW5: Item Response Theory/ Factor Analysis (IRT/IFA) on Your Own Data
16 points; due Monday 4/22/2024 by 11:59 PM via ICON

Please submit this HW5 in an editable format (e.g., .docx or .rtf extension) using this file-naming convention: PSQF6249_Lastname_Firstname_HW5

The goal of HW5 is for you to practice estimating factor analysis-type models on categorical (binary or ordinal) item responses that you care about; ideally these are the same data you analyzed for HW3. If you have other item response formats, please ask Lesa for advice on how to make those item responses work for these purposes.

If you have **six or more items measuring a single dimension**, you may use only the items that correspond to a single dimension. If you have **fewer than six items** measuring a single dimension, please use enough items for **two dimensions** at once so that your model will be testable. Once you know how this analytic process works, you will be able to repeat it as needed for your other dimensions of interest, so the idea is to start with a model of limited size for now (which will also keep this homework of comparable difficulty across students). Given the difference in model type relative to HW3, **please start from your originally hypothesized model and items again** (i.e., to see if the decisions you made would be the same under a different, likely more correct type of measurement model).

Use a z-scored factor model identification (factor mean = 0, factor variance = 1; otherwise known as anchoring by persons). **Please follow all instructions already given in HW3 with respect to asking for help if needed, professional writing style, and the use of APA format for tables, figures, and text.**

Items (and their point values) to be included (you can earn up to 2 points for writing quality and proper use of APA style):

1. Begin by summarizing the construct(s) being measured and the indicators themselves, including how many there are and their response options. Also provide your sample size and briefly describe the sample. Provide all relevant modeling info: program, estimator(s), how each model was identified, and how models will be compared using a given estimator. The idea is that a reader should be able to replicate your analyses given the information provided. **You can start with the text you wrote for HW3, but make sure to revise it so that it correctly describes the current IFA/IRT models (their parameters and interpretation)**. You may borrow the wording used in my examples (5 or 6a) as needed. **(1 point)**

2. Provide a tetrachoric (for binary items) or polychoric (for ordinal items) correlation matrix for your item responses, grouping items that should measure the same latent factor together. Also provide the Pearson correlation matrix across items (previously reported in HW3) for comparison purposes. How do the conclusions about the inter-item relationships change across these methods of estimation? **(2 points)**

3. First estimate a measurement model that corresponds to your hypothesized dimensionality in Mplus using WLSMV and PARAMETERIZATION=THETA (also ask for RESDIUAL and STDYX on the OUTPUT command). Select the same options if you are using lavaan instead.

Report the relevant fit statistics and describe by which indices good fit has been achieved globally, including the chi-square test, CFI, TLI, RMSEA, and SRMR. Examine and describe local misfit using the residuals (i.e., discrepancies between model and data) for the predicted correlations. If your model fit is not adequate, report its sources of local misfit and re-specify the model to try to improve fit. Note that any model modifications should also be theoretically defensible, so provide a rationale for these modifications (or describe why you didn't modify the model). Describe the model modification process you followed and conduct any relevant model comparisons to support your modifications. As before, your goal whose fit is as good as it is going to get but still be theoretically defensible. **(4 points)**

4. Re-estimate your final model using ML estimation and LINK=LOGIT and add the plot options (note: these are only available when using Mplus on a Windows OS). Note that if you estimated residual covariances when using WLMSV, you will need to turn them into specific factors instead when using ML (see Lecture 5b slides 36–37). If you encounter estimation problems when using ML, please ask me for help troubleshooting. Once the model has estimated without error messages, use the output and the plots to do the following:

    a. Make a table of your final model parameters, including all unstandardized IFA parameters and their SEs. Use the "text to columns" feature in the Data menu of Excel to make this easier, but make sure each parameter is clearly labeled (i.e., do not leave the impoverished labels used per indicator threshold by Mplus). Also provide the corresponding IRT discrimination and difficulty parameters for each item (note: these are only estimated in Mplus by default for binary items, so you will need to use MODEL CONSTRAINT to estimate these for polytomous items or compute them yourself using the Example 5 or 6a spreadsheets). **(3 points)**

    b. Provide and reference a density plot (second option in histogram menu) of your sample's FSCORE distribution. Note that Mplus will do this for you as a PLOT option; otherwise, import the saved FSCORE file into another package to do so. Also make a plot of reliability from test information <u>using the same x-axis as your histogram</u>. How informative are these items for your sample given your goals of measurement? **(2 points)**

    c. Provide and reference a plot describing the spread of difficulty values across responses for each item (see the Example 5 or 6a spreadsheets for an example). How well do the responses appear differentiated across categories? Are there any response options that do not appear useful? Given what you've found, would you suggest a different response format for future work with these items? **(2 points)**