Data Activity
ITEMS Module 05: Diagnostic Measurement – GDINA Framework

Wenchao Ma & Jimmy de la Torre

Instructions

In this exercise, please use the GDINA GUI program to analyze the practice data, which consists simulated responses of 837 students to 15 items. The data and Q-matrix are saved in **practice_data.txt** and **practice_Q.txt**, respectively, which are available in the '**Resources**' section of the player frame as part of the digital ITEMS module.

Your task is to fit a fully specified / saturated GDINA model to these data and compare its fit to the fit of several more restricted models. Once you have found a well-fitting model, you will need to interpret the item and person parameters and create a diagnostic score report for a student.

Questions

Part 1 – Model Estimation and Selection

(1) Empirically refine the Q-matrix using the PVAF method based on .95 cutoff. If any modifications are suggested, compare the G-DINA model with the original and modified Q-matrices in terms of AIC and BIC. Does the modified Q-matrix yield better relative fit under the G-DINA model?

Model	AIC	BIC	# of parameters
G-DINA model with original Q-matrix			
G-DINA model with modified Q-matrix			

For the following questions, use the modified Q-matrix that you created.

(2) Fit the data using the G-DINA model and DINA model, and compare their number of parameters, AIC and BIC. Also, examine whether the DINA model can fit the data as well as the G-DINA model using the likelihood ratio test.

Model	Deviance	AIC	BIC	# of parameters	LR statistic	*df*	*p*
G-DINA							
DINA							

(3) Perform the Wald test to examine if any of the other reduced models (i.e., DINA, DINO, A-CDM, LLM and RRUM) can be used in place of the G-DINA model without a notable loss of model-data fit for each item that measures two or more attributes. What are the suggested models based on the default decision rule of the GDINA GUI program?

Item no.	1	2	3	4	5	6	7	8
Model								
Item no.	9	10	11	12	13	14	15	
Model								

(4) Fit the models selected by the Wald test in Question (3). Can the combination of models selected by the Wald test fit the data as well as the G-DINA model?

Model	Deviance	AIC	BIC	# of parameters	LR statistic	*df*	*p*
G-DINA							
Wald-selected models							

For the following questions choose either the G-DINA model or the Wald-selected model, depending on which one fits the data better.

Part 2 – Parameter Interpretation and Usage

(5) Find the estimated attribute profile for student #164. What are the estimated response probabilities for the latent classes for this student? Which attributes has the student most likely mastered or not mastered? Which attributes are we most certain about and for which attributes would we require more data to be certain for this student?

(6) Find the estimated item parameters for item #1. What are the diagnostic properties of this item? Is this an item with desirable measurement properties and would you recommend it for inclusion "as-is", potential revision, or potential removal from the pool?

(7) Find the estimated latent class membership probabilities for the cohort of students. What does that tell you about the skill profiles of the students?

(8) Find the estimated attribute mastery rates for the cohort of students. How do these mastery rates align with the skill profile information from the previous question?

(9) Create a diagnostic score report for student #20 (e.g., to provide guidance to the student for how to improve) as well as for the cohort of students overall (e.g., to provide instructional guidance to the teacher). Below are two sample templates that you can use for this purpose.

(10) What other kinds of materials would be valuable to have to give to the student or the teacher so that the recommendations that you made in the previous questions are truly actionable in practice?