IRT workshop

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30 January 2014

Overview

1. Overview of the Course & IRT
2. Introduction to IRT
3. Introduction to R

- Name
- What is your statistical/mathematical background?
- How do you anticipate using IRT (presently or in the future) and what models you are interested in?
- Expectations and goals of this workshop

Purpose of the workshop

To **introduce** IRT concepts and their **applications** through the use of the **R** programming language

My expectations

- Come prepared, i.e. do readings outside of the workshop; as there is a focus on application during class time
- Spend time outside of class to learn about `R` and re-run all code
- Act professionally during class
- Provide feedback throughout; this workshop is for you and should be worth your time
    - If something isn't working let me know, if something is working let me know.

Administrative business

- Meet once every two weeks (except we are meeting next week).
  - 30/1, 6/2, 20/2, 6/3, 20/3, 3/4, and 17/4.
- Preferred time and day: Wednesday/Thursday/Friday.
- Meet for 2 hours.
- Comments? Do you want an additional session?

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- Readings
  - Text: Frank Baker's IRT book
  - Optional text: de Ayala, R. J. (2009). The theory and practice of item response theory.
  - I will assign required readings out of Baker's book and optional readings out of de Ayala's.
  - These readings will be used to supplement material, not necessarily mirror it

Proposed assignments?

- Every class meeting, we will work through code together. Alongside the code, there will be questions that need to be answered and turned in. These can be answered individually, with a partner, or as a class.
  - The goal of these activities is for you to understand how the code is getting information for us and to demonstrate that you understand the IRT model we are investigating.
- A short-paper showing that you know how to run and interpret an IRT model.
  - Very brief intro and discussion; the bulk of this paper will be on methods (describing the IRT model you chose and why it's appropriate) and the results (assessing model fit, interpretating, and demonstrating understanding of model output).
  - I will provide a rubric that will show you what needs to be included.
  - Can you use a class dataset or, preferably, your own.
- Presentation on your paper (12 - 15 minutes).

Proposed topics

Introduction to R (30/1)	Polytomous models (20/3)
1-PL and Rasch model (6/2)	Latent class analysis (3/4)
2-PL model (20/2)	Addl topics & Presentations (17/4)
3-PL model (6/3)	

These topics are flexible and it's very likely it will all take all 6 remaining sessions to get through these topics.

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- Latent variables may be conceptualized continuous, categorical, or both.

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- Anxiety could be loosely defined as *feelings* that range from general uneasienss to incapcitating attacks of terror
- Should anxiety be conceptualized as observed or latent?
- Is anxiety continuous, categorical, or both?
  - Categorical - Individuals can be placed into a high anxiety latent class and a low anxiety latent class
  - Continuous - Individuals fall along an anxiety continuum with one end being low anxiety and another end high anxiety
  - Both - Given a latent class (e.g. the high anxiety latent class), within this class there is a continuum of even greater anxiety.

How to measure generalized anxiety?

- Used observed (i.e. *manifest* variables) that provide a proxy of generalized anxiety
- These provide our *operationalized definition* of generalized anxiety
- But how do we put these observed measures onto the generalized anxiety scale?

Issues in measurement

- Reliability
- Validity
  - High reliability is imperative for high validity
- Invariance
  - Want our instruments to be independent of what they are measuring
- Scale of the variable
  - Ratio - Continuous scale with an absolute zero
  - Interval - Continuous scale with a relative zero
  - Ordinal - Categorical, natural order to data
  - Nominal - Categorical, no natural order to data

Item Response Theory

- A system of models that establish the corresponds between latent variables and manifest variables
- Uses latent characteristics of individuals and items as predictors of observed responses
- Doesn't help us answer the how and why of a latent construct, despite the name "theory"
- Places persons and items on the same continuum

Properties and assumptions

- Properties
  - Manifest variables can differentitate among persons located at different locations on the latent variable scale
  - Individuals are characterized in terms of their location on the latent variable
  - Items are characterized with respect to their locations and capacity to discriminate among person
  - Items and persons are placed on the same scale.
- Assumptions
  - The latent variable is unidimensional (typically)
  - Local independence of items
    - Within a item at different abilities across items
  - Response of a person to an item can be modeled with the a specific item reponse function

Item Parameters

IRT: Item parameters: difficulty (b) and discrimination (a) - estimated in one sample from a population are linearly transformable to estimates of those parameters on another sample from the same population. This makes it possible to create large pools of items that have been linked by this transformation process onto a common scale

Unlike CTT, equating occurs automatically as a result of linking, without assumption of score distributions. This makes it possible to compare on a common scale persons measured in different groups and with different items.

Estimation and SEM

- CTT, uses number-correct score dependent on number of items on a test, their difficulty and the scores are limitied to fixed values and interpretable on a within-group normative basis.
- IRT, Uses ML scoring of IRT-based tests to yield a trait scores independent of number of items, item difficultity, and the individuals it is measured on, and is placed on a real-number scale.
- In CTT, SEM is group dependent and constant for a group.
- In IRT, SEM is independent of group; allows individual SEMs based on performance and item parameters; and can also provide conditional SEMs based on different levels of the trait.

Other traits of IRT

- Use test information function for designing a test
- Has methods for examing item fit for identifying items that misfit
- Has methods for examing person fit for identifying persons that misfit
- Adaptive testing can be implemented (e.g. CAT)
- IRT is a family of models for various response types and could be used with multidimensional data.

Tools for the IRT workshop

- R programming language: http://www.r-project.org
- Rstudio (optional, but highly recommended if you are new to R): http://www.rstudio.com/
  - Rstudio is an IDE for R that greatly expands the default R editor and makes it more user-friendly and uniform across the OSs.
  - So . . . , Rstudio is R with some pretty makeup
- Various R packages
  - These will be installed in an ad-hoc fashion via R scripts

Why R?

1. R is free
2. R is open-source
   - All code is 100% visible to the user and can be expanded or audited by anyone.
3. R can do everything
4. R is cutting edge
5. R is cross-platform
6. Once you learn R, it's actually easy

Next time

- Please:
  - Read Chapters 1 & 2 in Baker, ignoring the Computer Session sections
  - Optional: de Ayala chapter 2
  - Learn more R and play around with it.
  - Look at Verzani's simpleR if you have time: http://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf