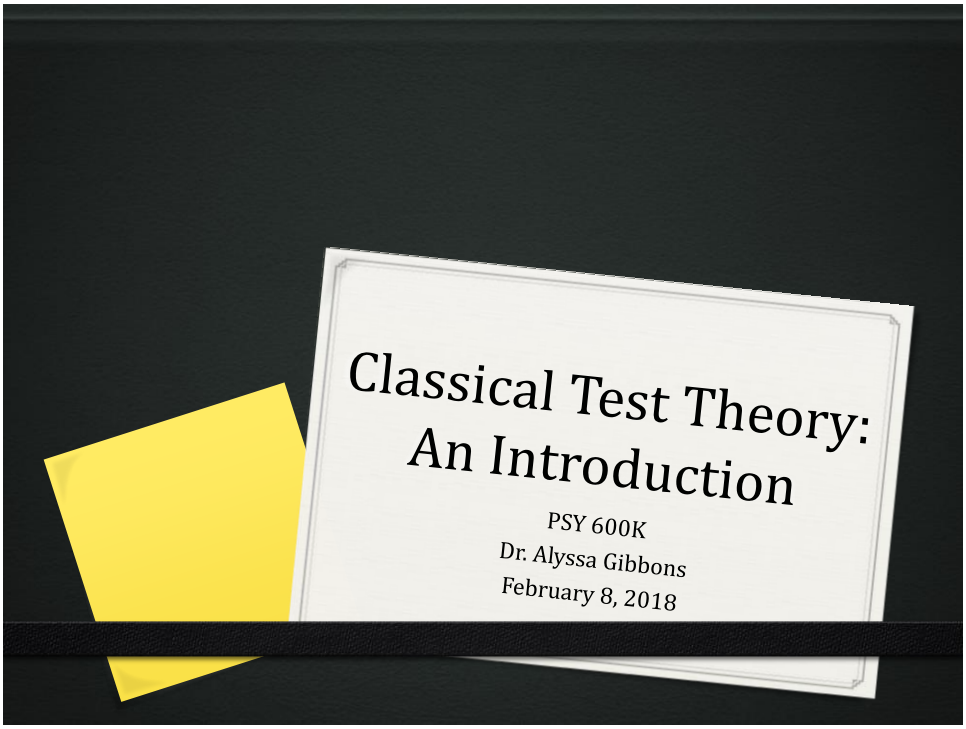


Agenda

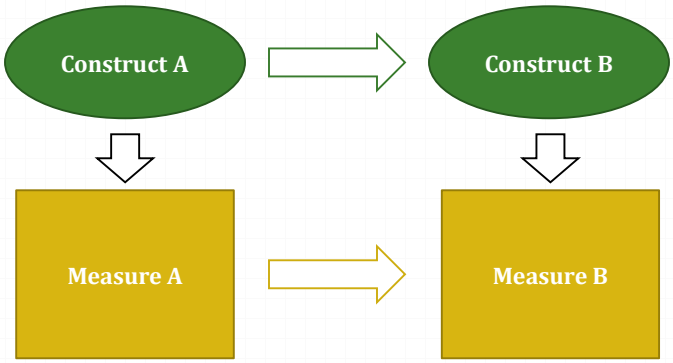
- Introducing classical test theory
  - Relating constructs and measures.
  - The CTT equation.
  - The true score part:
    - Constructs as causes of item responses.
    - Path diagrams and the parallel tests model.

Classical Test Theory

- Almost everything we'll discuss for the rest of the semester falls under the broad heading of classical test theory.
- A few points to remember:
  - This is a **theory** about how item & test scores relate to constructs.
  - It's not the only theory out there.
    - Generalizability theory
    - Item response theory
    - Although all of these are related…
- We don't really test CTT as a *whole*.
  - R & M will go into great detail about this. ☺
- We do, however, test the adequacy of our particular CTT-based model for our data, and use CTT to make and test predictions about items and tests.

Constructs & Measures

- From DeVellis, p. 18:



Implications

- Constructs are unobservable; therefore, the true relationship between two constructs is also unobservable.
- Measures are imperfect indicators of constructs; however, they are related to constructs and can be used to estimate constructs.
- The more closely our measures correspond to our constructs, the more accurate our estimate of the relationship between constructs will be.
  - And CTT is all about quantifying the relationship between measures and constructs.

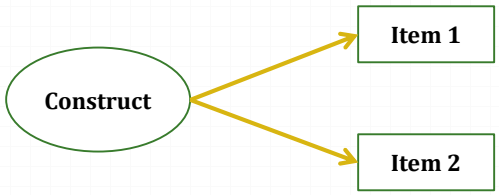
The CTT Equation

- Memorize this one:
  - X = T + E
  - Observed score = True score + Error
- Our measures = some combination of true characteristics and error.
  - This is a definition, not a hypothesis.
    - More on this next time.
  - Holds for overall test scores as well as individual items.
- Let's talk about the true score part first.

Latent Variables Cause Item Responses

- In CTT, constructs are presumed to be characteristics of persons.
  - Each person has a *true score* (at the time of measurement).
  - Any particular person's true score is unknowable; however, we can estimate true scores with varying degrees of precision.
  - A person's true score on the construct affects their choice of response to a test item.
- Implies that:
  - There should be a correlation between item response and true score.
  - There should be correlations between items measuring the same true score.

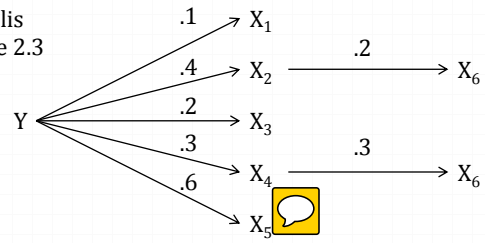
Common Cause



- We argue that the correlation between two items is due to the **common** effect of a 3rd variable – the construct.
  - Item 1 does not cause Item 2 or vice versa.

Correlations & Path Diagrams

DeVellis Figure 2.3



$r_{15} = .06$

$r_{12} = .04$

$r_{25} = .24$

etc...

- Standardized path coefficients.
  - How would you interpret them?
- Correlation between two Xs = product of their path coefficients.
- We typically know the item correlations, not the path coefficients…
  - But we can use this principle to solve a system of equations to find them.

Parallel Tests

- This is quite easy if you can satisfy the assumptions of the **parallel tests model**.
  - Note that "tests" can = items, subtests, etc.
- Assumptions:
  - The latent variable influences all paths equally (all path coefficients from construct to item are the same).
  - All items have the same amount of error.
- Implies:
  - All correlations between items are equal.
  - All item means and variances are equal.
- If these hold, then the common standardized path coefficient then equals the square root of the common correlation between items.
- Useful, huh? Is it?

Less Restrictive Models

- Parallel tests model rarely holds. Fortunately, there are other ways to get those path coefficients!

Model	Equal Loadings?	Equal Errors?	Equal Item Means?	# Latent Variables ?
Parallel	Yes	Yes	Yes	1
Tau-equivalent (or TSE)	Yes	No	No	1
Congeneric	No	No	No	1
General factor model	No	No	No	Many

- Are parallel tests just a historical artifact?
  - What value do these models have for us today?

Questions?

For next time:

CTT-Based Models

Read: R & M 5.1 – 5.3

Lab Friday: Intro to R and Matrix Algebra