Empirical Methods for Evaluating Maps: Illustrations and Results

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Methods for Evaluating Map Structure

• External outcomes
• Classical item statistics
• Unidimensional models
A Framework for Map Evaluation

• Diagnostic Classification Models (DCMs)
• Mastery profiles on the set of assessed skills
• Three methods
  – Patterns of Mastery Profiles
  – Patterns of Mastery Assignment
  – Patterns of Attribute Difficulty
An Illustrative Example

- 3 attribute assessment
- Linear map structure
Map Structure in a DCM Context
Patterns of Mastery Profiles

• Estimate two models
  – Saturated model with all profiles
  – Reduced model with only hypothesized profiles

• Assess model fit
  – Posterior predictive model checks
  – Model comparisons

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Patterns of Attribute Mastery

- Estimate each attribute as a separate 1-attribute DCM (equivalent to LCA)
- Set mastery threshold (0.8)

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Patterns of Attribute Difficulty

- Measure attribute difficulty using classical \( p \)-values
- Group similar respondents \textit{a priori}
- Calculate the weighted average \( p \)-value for each attribute and group
Case Study: Dynamic Learning Maps

- Each Essential Element (EE) available at multiple levels of depth, breadth, and complexity
  - 5 levels in ELA and mathematics
  - 3 levels in science
- Linkage levels are assumed to follow a linear progression
- Students test on only one linkage level for each EE during the operational assessment
Case Study: Dynamic Learning Maps

- Patterns of Profile Mastery
  - Models fail to converge due to missing data
- Patterns of Attribute Mastery
  - The majority of flags were in ELA
  - More flags for higher linkage level reversals than lower
Case Study: Dynamic Learning Maps

• Patterns of Attribute Difficulty
  – Flags by subject
    • 28 ELA EEs
    • 35 mathematics EEs
    • 0 science EEs
Summary

• Benefits and limitations of each method within the framework
• Wide breadth of methods provides complementary information
• Application to DLM shows insights that can be applied to future test and map development
Ongoing Research

• Continue to refine methods
  – Alternative modeling strategies for Patterns of Mastery Profiles
  – Simulation studies to inform empirical flagging criteria
• Expanding beyond the progression of linkage levels within EEs to the more fine-grained map structure
More Information

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