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

![Graph showing Map Structure in a DCM Context](image-url)
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 *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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