Enabling Computer Adaptive Assessments For Slider-Bar Item Types With the Three-Part Beta Measurement Model

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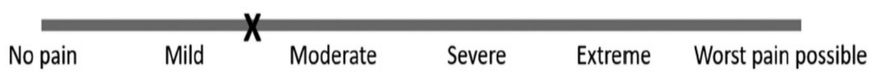
Introduction

- We develop a new psychometric model for constructing adaptive assessments based on the slider-bar item type.
- The slider-bar format (continuous rating scales, in general) are becoming increasingly popular, especially in online assessment, however adaptive models for continuous item types are sparse (due to constant item information functions).
- Our model, called the 3-Part Beta factor model (3PB), is mixture between a beta and a Bernoulli distribution.
- A main feature of the 3PB factor model is a non-constant item information function, which enables computerized adaptive assessments.

Example of Slider-Bar Format



Item Calibration & CAT Simulation

Phase 1 – Item Calibration

Fit SDI items with 3PB model
- R = 739 complete cases
- I = 21 slider-bar items
- Analyses conducted via R and Argon HPC System
- HMC estimation in Stan

→ Extract posterior item parameter estimates

Phase 2 – Administration of SDI to New Sample of (Simulated) Examinees

Simulate 750 examinees with $\theta \in \{-2, 0, 2\}$

Calculate Information of each item
- Select item that maximizes information for the estimated value of $\hat{\theta}$.
- All examinees initialized at $\hat{\theta} = 0$.

Generate a response based on selected item
- $X \sim 3PBD(\zeta, \gamma, \mu, \phi)$

Update $\hat{\theta}$
- Run HMC chains treating all other parameters as known

Results

Figure 1. 3PB Item Information for Hypothetical Item

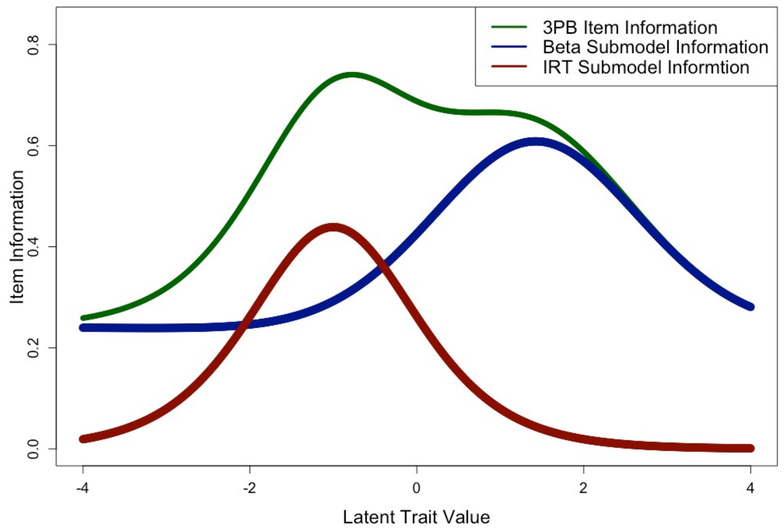


Figure 2. Estimated Latent Trait Value

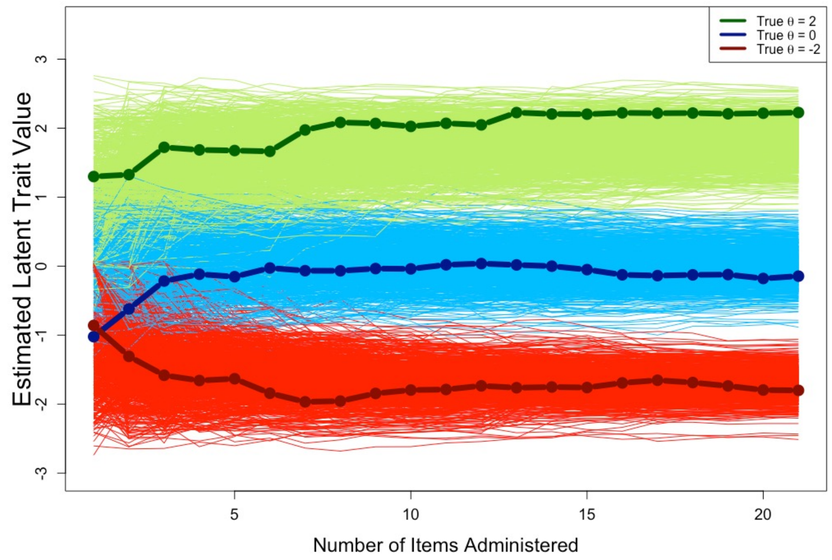


Figure 3. RMSE Across Administration of Items

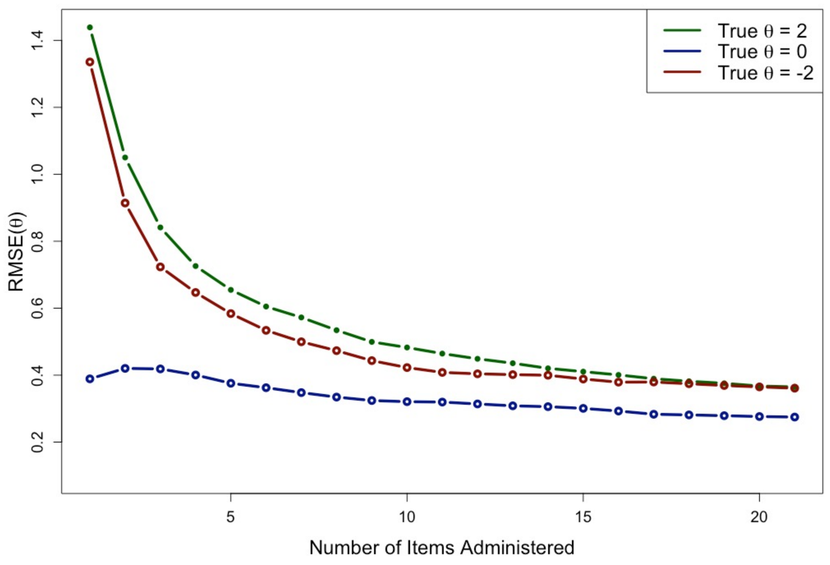
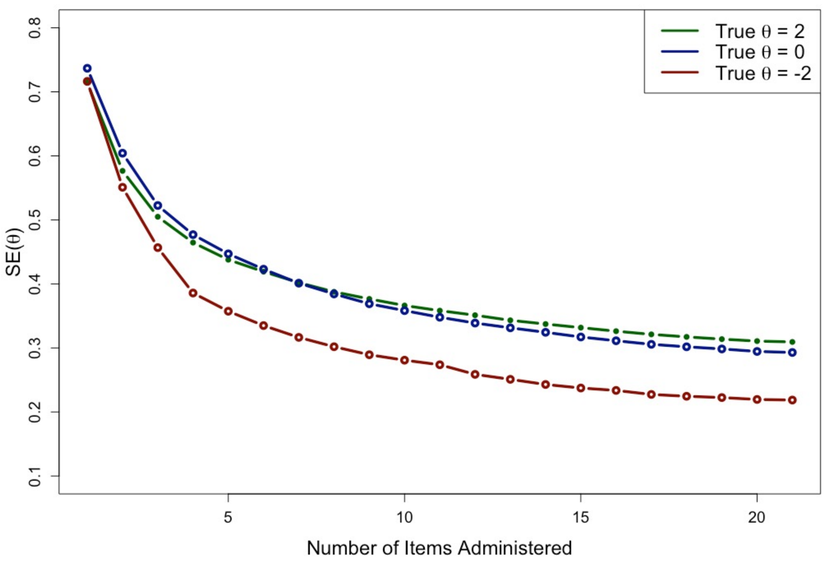


Figure 4. SE(θ) Across Administration of Items



Conclusion

- We provide a proof-of-concept study demonstrating the potential of the 3PB factor model in constructing an adaptive assessment for the slider-bar item type.
- Preliminary findings suggest the 3PB factor model is capable of providing informative assessments with a shorter number of items.
- Study extends application of CAT to incorporate non-discrete item types.
- Future research will further investigate properties of 3PB factor model and applicability of model in various contexts.

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