Constructing an item selection procedure as a set of linear test

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A project presentation for the irtND (PEM) lab

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Overview

1. Background
   - Context
2. Item Selection
3. Proposed Solution
4. Study
5. Results
6. Discussion

Context of the Study

- Item selection rates should be (and sometimes are) a large concern in CAT
- Traditional selection procedures favor item selection based on item properties
  - Information - highly influenced by the discrimination parameter.

Context of the Study

- Reasons we care about item selection rates:
  - CATs are typically administered in a continuous testing environement
  - CATs are usually high stakes

Item Selection Procedures

- Usually based sequentially on item properties
  1) Maximum Fisher Information
  2) B-Matching
  3) KL - Information

Item Exposure Control

- Types:
  1) Probability Based (Sympson-Hetter)
  2) Algorithm based (Stratified Procedures)

Issues:

- Issues with current methods:
  1) Probability based: Cannot increase the exposure of items
  2) Algorithm based: Destined to be sub-optimal

The basic idea

- Construct a set of linear tests for a set of windows that are jointly optimal.
  - Break the ability distribution into a set of windows of equal probability
  - Construct a set of forms that correspond to each window, that are optimial for each window
  - We define optimality by Maximum Fisher Information at the midpoint of the window
  - Constrain each item to appear a maximum number of times in each window.

The basic idea

- Administer the test:
  1.) Administer an item at random
  2.) Update ability
  3.) Partition ability estimate into a given window
  4.) Randomly select a form from a window
  5.) Randomly select and item from a form
  6.) Repeat step 2-5 until the test terminates (Fixed Length)

Simulation Study

- Study Steps:
  1) Item selection: New Method, F, FSH, ASBB
  2) ability levels: -1, 0, 1, Normal(0,1) - Just for exposure rate comparison
  3) Test length (27)

Power

MFI: Unconstrained

	-1	0	1
Bias	.01	.01	.01
RMSE	.27	.25	.25

New Method:

	-1	0	1
Bias	.006	.028	.004
RMSE	.36	.38	.36

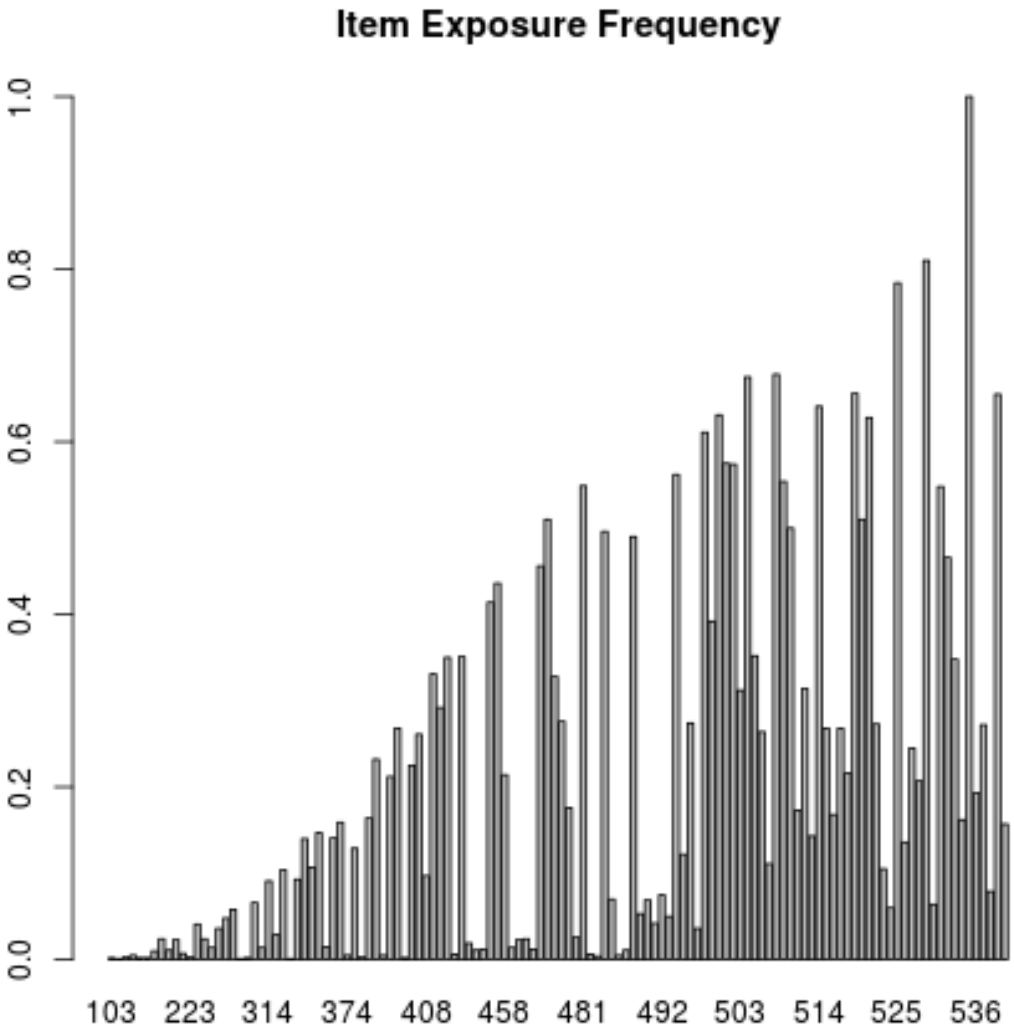
FSH:

	-1	0	1
Bias	-.02	-.03	-.01
RMSE	.35	.31	.30

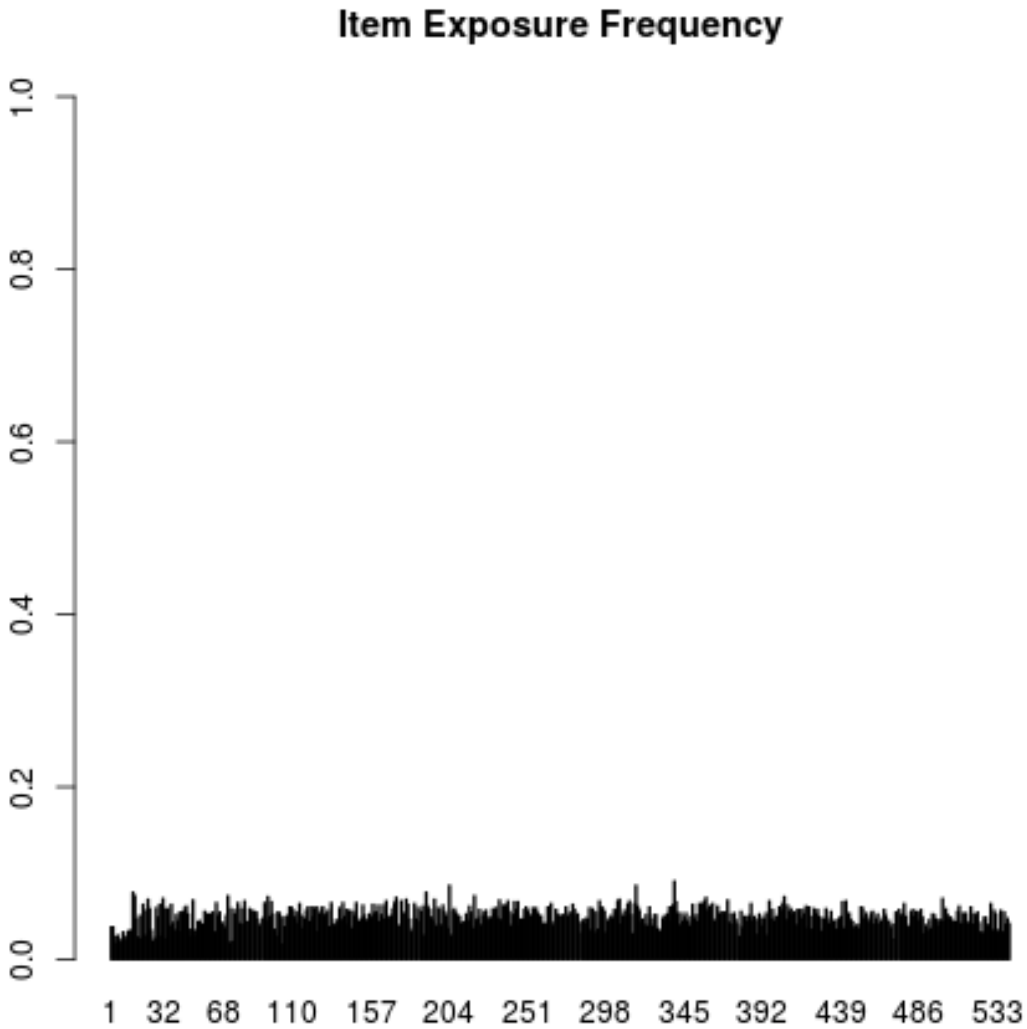
ASBB:

	-1	0	1
Bias	-.06	-.02	.01
RMSE	.47	.41	.35

MFI


Item Exposure Frequency
0.0
0.2
0.4
0.6
0.8
1.0
103
223
314
374
408
458
481
492
503
514
525
536

New Method


Item Exposure Frequency
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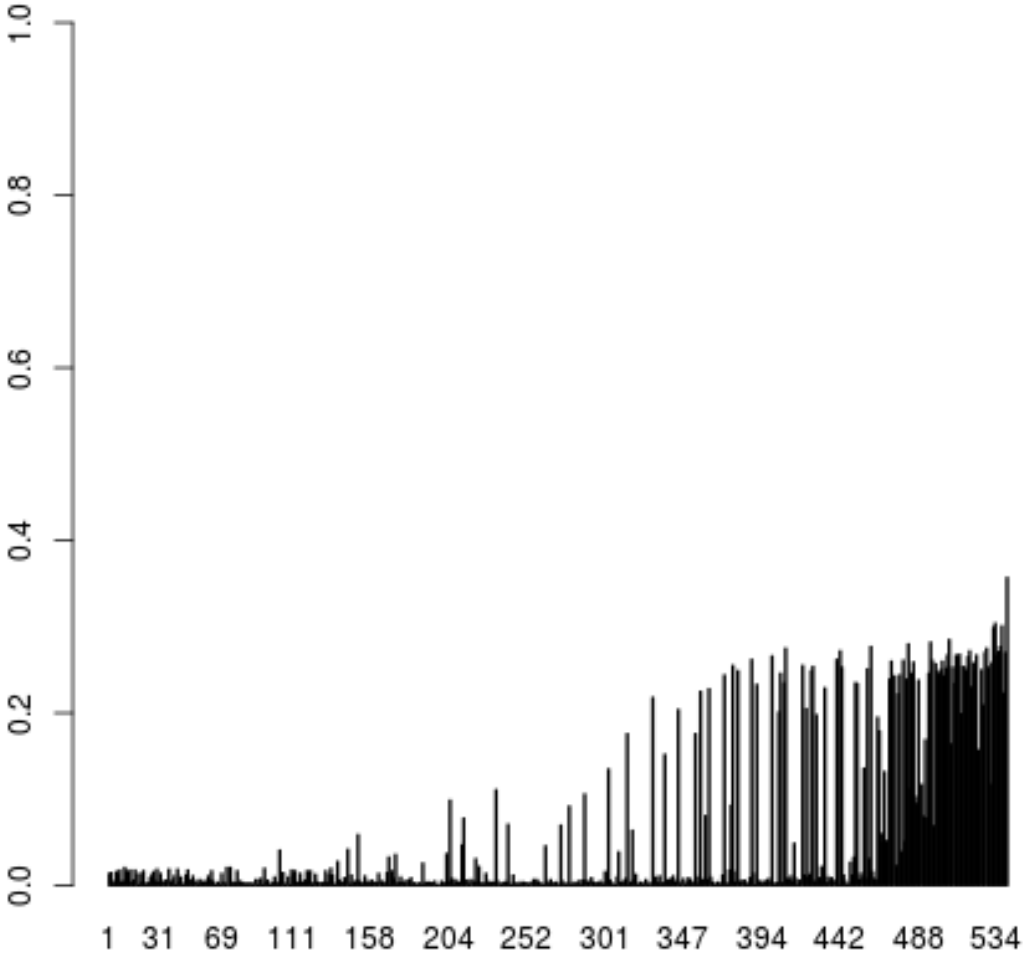
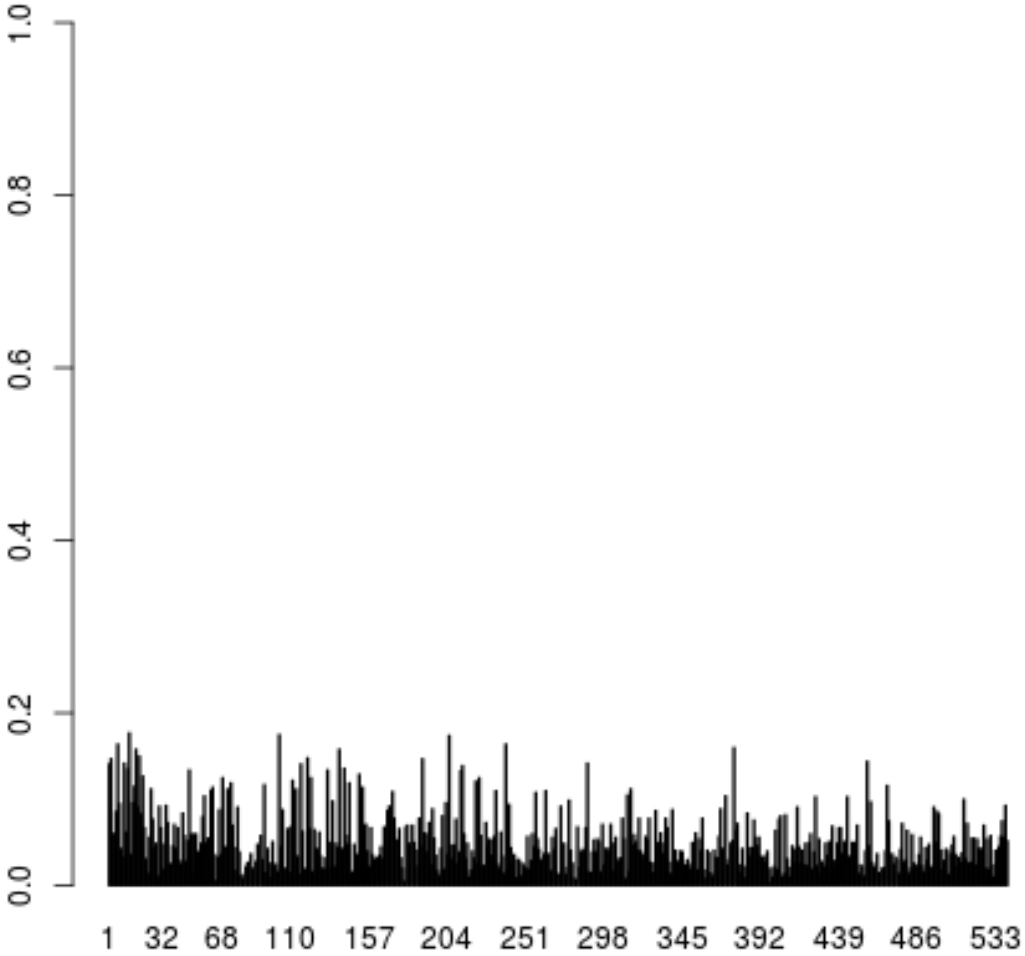
0.8
0.6
0.4
0.2
0.0
1
32
68
110
157
204
251
298
345
392
439
486
533

FSH



AS-BB



Limitations

- Limitations:
  1) Computationally intensive
  2) Tricky to specify apporpriatly