Item Selection Methods based on Multiple Objective Approaches for Classification of Respondents into Multiple Levels

Maaike van Groen, Theo Eggen & Bernard Veldkamp
2nd IACAT Conference, October, 2011, Monterey
Is it possible to develop new item selection methods which take advantage of the fact that we want to classify into multiple categories?
Is it possible to develop new item selection methods which take advantage of the fact that we want to classify into multiple categories?
Is it possible to develop new item selection methods which take advantage of the fact that we want to classify into multiple categories?
Is it possible to develop new item selection methods which take advantage of the fact that we want to classify into multiple categories?
Classification Testing

- Classification into one of several, mutually exclusive categories

Wald, 1947; Eggen & Straetmans, 2000
Item Selection Methods

- Selecting the (next) item based on some criterion

- Objective:
  Maximization of Fisher information at some point on the ability scale
Item Selection Methods

Sequential Classification Testing

\[\text{\n\[\text{Adaptive Classification Testing}\n\]
}\]

Current Study
Classification Testing
Item Selection
Simulation Study
Conclusion
Current methods (Eggen & Straetmans, 2000)

- Randomization
- Maximization at the middle of the cutting points
- Maximization at the nearest cutting point
- Maximization at the current ability estimate
New methods

- Taking multiple points on the ability scale into account
- Based on multiple objective approaches (Veldkamp, 1999)
New methods

- **Multiple objective approaches**
  - Weighting methods
  - Ranking or prioritizing methods
- **Goal programming methods**
- **Global criterion methods**
- **Maximin methods**
- **Constraint based methods**

Current Study
Classification Testing
Item Selection
Simulation Study
Conclusion
Simulation Study

Two item pools:
• 500 items
• $\alpha \sim N(1.0,0.25)$
• $\beta \sim N(0.0,1.0)$ & $\beta \sim N(0.0,2.0)$

Simulees:
• 1000 simulees per item selection method, $\theta \sim N(0.0,1.0)$

SPRT:
• $\alpha=\beta=0.05$
• $\delta=0.10$
• Cutting points: -1.0 & 1.0

8 item selection methods
## Simulation Study: Results

<table>
<thead>
<tr>
<th>Item Selection Method</th>
<th>Broad Item Pool</th>
<th>Peaked Item Pool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ATL</td>
<td>PCD</td>
</tr>
<tr>
<td>Random</td>
<td>99.0</td>
<td>0.77</td>
</tr>
<tr>
<td>Estimate Based</td>
<td>77.1</td>
<td>0.88</td>
</tr>
<tr>
<td>Middle Cutting Points</td>
<td>78.6</td>
<td>0.89</td>
</tr>
<tr>
<td>Nearest Cutting Point</td>
<td>80.5</td>
<td>0.86</td>
</tr>
<tr>
<td>Weighting Method</td>
<td>79.3</td>
<td>0.87</td>
</tr>
<tr>
<td>Goal Programming Method</td>
<td>82.3</td>
<td>0.87</td>
</tr>
<tr>
<td>Global-Criterion Method</td>
<td>86.0</td>
<td>0.85</td>
</tr>
<tr>
<td>Maximin Method</td>
<td>85.6</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Note: ATL = average test length, PCD = percentage of correct decisions.
Conclusion

- Sequential Classification Tests have higher ATL than Adaptive Classification Tests.
- Sequential Classification Tests have slightly lower PCD than Adaptive Classification Tests.
- Results also hold with three and four cutting points.
Concluding remarks:

- Other item pools
- Other SPRT settings
- Other ability distributions
- Lower maximum number of items
- High average test length
- Other methods can be based on multiple objective approaches