Banding in Personnel Selection Within a CSEM Framework

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Cite as:

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Methods of banding in personnel selection have received considerable attention (see e.g., Campion et al., 2001; Cascio, Goldstein, Outtz, & Zedeck, 1995; Schmidt & Hunter, 1995). More recently, however, advances in statistical methods have highlighted issues related to classical test theory (CTT) approaches to establishing bands that may affect their validity and utility (Bobko & Roth, 2004, 2005; Raju, Price, Oshima, & Nering, 2007). Indeed, the psychometric weaknesses associated with estimating the standard error of measurement (SEM) with CTT methods are widely understood (see e.g., Allen & Yen, 1979; Nunnally & Bernstein, 1994). Alternatives based on conditional standard error of measurement (CSEM) models are more accurate and have been available for over 50 years (Feldt, Steffen, & Gupta, 1985; Lord, 1984). This paper presents a more updated and contemporary approach to establishing score bands using CSEM methods.

Classical Banding

The history, philosophy, and rationale underlying banding as a method of increasing workforce diversity is well documented in the 1995 special edition of Human Performance (v. 8). Current banding methodologies are based on classical test theory (CTT) models of SEM where the SEM is assumed to be the same across the full range of test scores. The estimated SEM is used to establish the standard error of the difference (SED), which is the standard deviation of the difference in two independent scores. To ensure that scores in adjacent bands differ with a 95% confidence interval, the width of a band is set to $1.96 \times SED$. Therefore, banding methods based on classical test theory are established based on one SEM, which assumes that reliability is the same across the full score range.
CSEM-Based Banding

More accurate psychometric models recognize that test reliability varies across the score range and conditional SEMs (CSEM) are estimated at each point along the score range (Feldt & Brennan, 1989; Qualls-Payne, 1992). Consequently, methods of banding within the CSEM framework are different than traditional methods. Instead of a single SEM assumed for all scores across a test, the SEM differs at each score across the score range within the CSEM framework. Traditional banding methods, which are based on one SEM, cannot be applied in the CSEM framework. This presentation addresses this challenge by demonstrating a new method of banding which was developed to work within the CSEM framework.

CSEM-Based Banding Model

The underlying logic of the proposed banding method is not new; it was developed in the standardized educational testing context (e.g. GRE). Much like banding in the CTT framework, the obtained bands in the proposed method must: (1) account for test unreliability and (2) be significantly different than adjacent bands. In operation, the process of establishing bands is driven by a simple rule: the lower-bound of a given band must not significantly overlap with the upper-bound of the band immediately below it. In keeping with traditional banding methodology, a 95% confidence interval is established for each band. Arguably, however, the confidence level can be adjusted to meet situational demands (Campion et al., 2001).

Application of CSEM-Based Banding Model

In application, the first band is established by the top score observed on a test\(^1\). The upper-bound of Band-1 is established by the top score and the lower-bound of Band-1 is

$$\text{TopScore} - 1.96 \times \text{CSEM}_{\text{TopScore}}.$$  

The next band is established by score-i with an upper bound

\(^1\) To avoid the banding issues detailed by Schmidt & Hunter (1995), the new banding model is an extension of the top-score-reference model.
(\(i+1.96 \times CSEM_i\)) that is significantly less than the lower-bound of Band-1

\((\text{TopScore} - 1.96 \times CSEM_{\text{TopScore}}\)). To identify score-\(i\), an iterative procedure is required, whereby the upper-bound for a given score is computed based off of its observed CSEM and compared to the lower-bound of Band-1. Band-2, has a unique upper-bound (\(i+1.96 \times CSEM_i\)) and lower-bound (\(i-1.96 \times CSEM_i\)). The next band is established through an iterative search for score-\(j\) with an upper-bound (\(j+1.96 \times CSEM_j\)) that is less than the lower-bound of Band-2 (\(i-1.96 \times CSEM_i\)). This process can be repeated until all test scores are exhausted. To demonstrate, Table 1 details this process with a hypothetical dataset.

**Table 1. Example—Establishing bands with CSEM.**

<table>
<thead>
<tr>
<th>Test Score</th>
<th>Band</th>
<th>CSEM</th>
<th>95% CI-Lower Bound</th>
<th>95% CI-Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>1</td>
<td>0.20</td>
<td>20 - 1.96 \times 0.2 = 19.61</td>
<td>20</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>1.10</td>
<td>19 - 1.96 \times 1.1 = 15.84</td>
<td>19 + 1.96 \times 1.1 = 21.16</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>1.20</td>
<td>18 - 1.96 \times 1.2 = 15.65</td>
<td>18 + 1.96 \times 1.2 = 20.35</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>1.30</td>
<td>17 - 1.96 \times 1.3 = 14.45</td>
<td>17 + 1.96 \times 1.3 = 19.55</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td>1.40</td>
<td>16 - 1.96 \times 1.4 = 13.26</td>
<td>16 + 1.96 \times 1.4 = 18.74</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>1.50</td>
<td>15 - 1.96 \times 1.5 = 12.06</td>
<td>15 + 1.96 \times 1.5 = 17.94</td>
</tr>
<tr>
<td>14</td>
<td>2</td>
<td>1.60</td>
<td>14 - 1.96 \times 1.6 = 10.86</td>
<td>14 + 1.96 \times 1.6 = 17.14</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>1.70</td>
<td>13 - 1.96 \times 1.7 = 9.67</td>
<td>13 + 1.96 \times 1.7 = 16.33</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>1.80</td>
<td>12 - 1.96 \times 1.8 = 8.47</td>
<td>12 + 1.96 \times 1.8 = 15.53</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>2.00</td>
<td>11 - 1.96 \times 2.0 = 7.08</td>
<td>11 + 1.96 \times 2.0 = 14.92</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>2.10</td>
<td>10 - 1.96 \times 2.1 = 5.88</td>
<td>10 + 1.96 \times 2.1 = 14.12</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>2.10</td>
<td>9 - 1.96 \times 2.1 = 4.88</td>
<td>9 + 1.96 \times 2.1 = 13.12</td>
</tr>
</tbody>
</table>

In Table 1, the lower bound for Band-1, which is established by the top score (20), is 19.61. The next score with an upper bound that is less than 19.61, is 17 (19.55). Given this, Band-1 is comprised of all scores between 18 and 20. Applying this method, Band-2 is obtained; the scores range between 11-17. These obtained bands are graphed in Figure 1.
Unlike SEM-based bands, the characteristic of the CSEM-bands vary. Applying the proposed methods, however, we are able to obtain bands that meet traditional banding requirements: (1) the bands account for test unreliability and (2) the scores within each band are significantly different than those of adjacent bands.

**Conclusion**

Banding based on classical test theory methods suffer from a lack of precision and other psychometric issues (Bobko & Roth, 2004). The criticisms detailed by Bobko and Roth (2004) highlights fundamental flaws that may be addressed if bands are established within a CSEM framework. The application of CSEM in banding is new and no methods exist to properly establish bands. Applying existing methods within the CSEM framework is inappropriate. This presentation hopes to address this gap by providing a comprehensive method of banding within a CSEM framework.
Reference


