A study on Normalization of scores from various School Boards

(After NTS Meeting of 26th August, 2011 at IIT, Delhi)

Indian Statistical Institute (ISI),
Kolkata
The data (in respect of class XII board examinations)

<table>
<thead>
<tr>
<th>Board</th>
<th>Which aggregate is used</th>
<th>Years</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>TN</td>
<td>Aggregates scores computed from six subjects</td>
<td>2007-10</td>
<td>5.6-7.3 lakh</td>
</tr>
<tr>
<td>WB</td>
<td>Aggregate scores computed from five subjects (excluding additional subject)</td>
<td>2007-09</td>
<td>3.0-4.6 lakh</td>
</tr>
<tr>
<td>CBSE</td>
<td>Aggregate scores computed from five subjects (excluding sixth subject)</td>
<td>2007-09</td>
<td>5.0-6.3 lakh</td>
</tr>
<tr>
<td>ICSE</td>
<td>Aggregate percentage computed from five, six or seven subjects, depending on the students’ choice</td>
<td>2007-10</td>
<td>23-56 thousand</td>
</tr>
</tbody>
</table>
Score/percentile measures studied

- Score of student divided by
  - 50th percentile score
  - 60th percentile score
  - 75th percentile score
  - 85th percentile score

- (Score of student – percentile score) divided by (Maximum attained score – percentile score), where ‘percentile score’ is
  - 50th percentile score
  - 60th percentile score
  - 75th percentile score
  - 85th percentile score

- 50th, 60th, 75th, 85th percentile
Figure 1
Figure 2
Percentile rank vs. aggregate score: cutoff 50%

Percentile rank vs. aggregate score: cutoff 60%

Percentile rank vs. aggregate score: cutoff 75%

Percentile rank vs. aggregate score: cutoff 85%

Figure 3
Summary of findings

• For each board, the patterns of the curves are stable from year to year.
• The patterns do not depend much on the cut-off percentile.
• There is some variation in the patterns across the different boards.
• The pattern of one board can be mapped to the pattern of another board through a monotone transformation.
Follow-up questions

• If the aggregate percentage is calculated for each student based on the respective number of subjects, will the conclusions change?
  – No substantial change.

• Will there be any merit in indicating the number of students in each percentile rank for each normalized score?
  – Percentile rank is already normalized for number of students.
  – Year-to-year variation does not depend much on the size of the board.
Follow-up questions (contd.)

- Will board-to-board difference reduce if only aggregate of Physics, Chemistry, Mathematics and Biology scores are used?
  - Board-to-board variation will reduce substantially.
  - Year-to-year variation within boards will increase marginally.
    (Next three slides show this with PCMB % scores for students with at least three out of the four subjects)
- If all board scores are made similar to that of one board through monotone transformation, would the measures continue to be stable over years?
  - That should be the case.
Another issue

• Suppose **aggregate board scores** are used together with a **common test score** through a weighted average
• Suppose both scores are brought to a scale of 0 to 100
• Board scores can have the most discriminating effect if the entire range (0 to 100) is fully utilized.
• This would happen if

\[
\text{Percentile rank of student} - \text{cut-off percentile rank} = \frac{\text{percentile rank} - \text{cut-off percentile rank}}{100 - \text{cut-off percentile score}} \times 100
\]

is used as score.
• Cut-off percentile rank may be chosen as 50%, 60%, 75% or 85%, depending on the envisaged enrollment capacity.
Standardized score 1

In the next slide, we plot the following quantity against the percentile rank:

*Normalized score of a student in his/her board*

\[
\text{Score of student} - 75^{\text{th}} \text{ percentile score} = \frac{\text{Maximum attained score} - 75^{\text{th}} \text{ percentile score}}{\text{Maximum attained score} - 75^{\text{th}} \text{ percentile score}} \times 100
\]

mapped by a monotone transformation to the corresponding normalized score for CBSE for that year.
Figure 4

Normalized score mapped to CBSE vs. percentile rank: cutoff 75 %
Comments on Standardized score 1

• This plot is the same as the CBSE part of the earlier plot.
• For a non-CBSE student, the matching normalized score in CBSE is the normalized score of a CBSE student having the same percentile rank as that non-CBSE student.
Standardized score 2

• In the next slide, we plot the following quantity against the percentile rank:

\[
\text{Normalized percentile rank} = \frac{\text{Percentile rank of student} - 75}{100 - 75} \times 100.
\]
Normalized percentile rank vs. percentile rank: cutoff 75%

Figure 5
Comments on Standardized score 2

• This curve will be the same for any board, any year.