

Input from the Core Committee to Chairman, CBSE

(From Proceedings of the 2nd Meeting of the Core Committee held on 31st October, 2012)

During the first meeting of the Core Committee, the Chairman had explained that for admissions to NIT's, 60% weight would be put on the students' performance in the JEE-main examination and the remaining 40% weight would be on Board scores at the class XII level. The task of the Core Committee is restricted to recommending appropriate normalization of the scores without altering these weights.

The Chairman, CBSE, had informed the Core Committee that all the boards have agreed to provide scores data in a specified proforma within a stipulated time, and as such the time available for processing that data would be short. He had also informed the Group that, in view of the disparity of subjects chosen by students within a board and between different boards, the aggregate would be computed from five subjects (with equal weights on a language, three science subjects and one other subject).

The Core Committee considered some preliminary analyses of the Board and AIEEE (precursor of the JEE-Main) scores data, and took into account the following facts.

1. The aggregate as well as subject score distributions vary greatly from one board to another. Some boards award high scores to many students, while others generally award low scores.
2. The distributions of aggregate as well as subject scores obtained by students of different boards in the AIEEE vary considerably. Students of some boards generally do better in AIEEE, while the students of some other boards generally have poor performance in AIEEE.

The Core Committee considered the following proposals for arriving at normalized Board scores.

Option 1. Use percentile of aggregate score¹ of each student in his/her board examination of that year as the normalized Board score.

Option 2. Use different linear transformations² for the aggregate scores of different boards so that the set of all transformed scores within a board for a particular year has a fixed mean and a fixed standard deviation.

¹ The percentile of score of a candidate in a particular examination is the percentage of candidates appearing in that particular examination that received the same or lower score. This is different from the score expressed in percentage. The relation between percentile and percentage score varies from one examination to another. For example, in the year 2007, a student at the 5th percentile of the CBSE class XII examination received 24.4% in aggregate marks, and a student at the 80th percentile received 78.8%. In the same year, a student at the 5th percentile of the class XII examination of the Tamil Nadu board received 41.5% in aggregate marks, while a student at the 80th percentile received 76.5%.

² A linear transformation of a score means multiplication/division of the score by a number and addition/subtraction of another number. For example, the z-score of a student in an examination is a linearly transformed version of the original score, obtained by subtracting the mean score (computed from all scores of that examination) from the student's score and then dividing the difference by the standard deviation of scores. A further linear transformation of the z-score could produce a set of scores with any desired mean and standard deviation.

- Option 3. Use different linear transformations for the aggregate scores of different boards so that the set of all transformed scores within a board for a particular year has the same mean and standard deviation as the set of scores obtained by the students of that board in JEE-Main.
- Option 4. Use different non-linear transformations for the aggregate scores of different boards so that the set of all transformed scores within a board for a particular year match specified percentiles of the set of scores obtained by the students of that board in JEE-Main.
- Option 5. Use variations of the above options, where the scores of the 'failed candidates' in a board and students with negative aggregate score in JEE-Main are ignored while computing mean and standard deviation.
- Option 6. Use variations of the above options, with subject-wise normalization before aggregation.
- Option 7. Use Rasch models that take into account relative difficulty levels of different subjects.

The Core Committee proceeded with the selection of the normalization scheme by reasoning as follows.

1. A Rasch (multi-level logistic) model, favoured by the Indian Centre for Assessment, Evaluation and Research (CAER), makes specific assumptions about the dependence of score on the difficulty level of a subject and a student's achievement. It is possible to check whether the data at hand fits the model. Large data sets are often found not to fit the model. Further, in the present situation, time for analysis would be limited and the data would be vast. It would not be prudent to use complicated models of this kind for the purpose of normalizing scores of so many boards. Thus, Option 7 is ruled out.
2. Any method based on separate normalization of each subject score for each board would be unsuitable for the present purpose, as the time available for analysis would be short, and there may be issues with the format and contents of data files provided by the different boards in 2013, which would be the first year of compilation of multi-source data at such a scale. Thus, Option 6 (various versions of which were mentioned by CAER) is ruled out. However, the possibility of subject-wise normalization may be revisited in future – after a reliable mechanism of detailed scores from various boards is put in place.
3. As different boards have different pass marks, and the pass percentages also vary somewhat from board to board, it was decided that Option 5 would not be used. This would also simplify computations, which would be an important issue at least in the year 2013.
4. Some versions of Option 3 had been studied in IIT Kanpur, while a version of Option 4 was suggested by the Australian Council of Educational Research (ACER). These two options use JEE-Main scores as anchor for calibrating board scores. Anchoring is generally advocated as a strategy to eliminate the presumption that students of all the boards have the same distribution of 'merit' (implied in Options 1 and 2). However, the following counter arguments were given by different members of the Core Committee.
 - (a) Anchoring with respect to the aggregate JEE-Main score does not eliminate assumptions. It merely replaces one assumption by another. The assumption implied by anchoring with respect to JEE-Main scores is that the latter score adequately represents the relevant 'merit'. This assumption is neither weaker nor more verifiable than the assumption of same 'merit' distribution in all boards.

- (b) There is no reason to presuppose that scores of JEE-Main, based only on a few subjects, would be a fairer indicator of 'merit'. This notion is further weakened by the effect of highly specialized coaching, to which poor students have less access.
- (c) Anchoring with respect to the aggregate JEE-Main score can only be done on the basis of scores obtained by candidates of a particular board that actually appeared for JEE-Main. This is mostly a subset of all the candidates appearing for the class XII examinations of that board. This subset may not be a representative sample of the board. Thus, there is the additional (hidden) assumption that sampling of students appearing for JEE-Main takes place similarly in all the boards.
- (d) When anchoring with respect to the aggregate JEE-Main score is used, a candidate may be unfairly penalized for the weak performance of other students of his/her board in JEE-Main.
- (e) Anchoring with respect to the aggregate JEE-Main score effectively increases the importance given to JEE-Main, and therefore distorts the decision to use 60 : 40 weight ratio on the JEE-Main scores and the board scores.
- (f) If one is prepared to embrace the assumption that the JEE-Main score adequately represents the requisite 'merit', then a cleaner strategy (not involving the additional assumption mentioned in (c) above) is not to use board scores at all. However, it is the prevailing discomfort with this assumption that must have led to the recent initiative to move away from AIEEE scores alone and to give importance to board examinations. Moving back towards that assumption would indicate muddled thinking regarding its acceptability.

In view of (a)–(f) above, Options 3 and 4 were discarded.

5. Options 1 and 2 seek to address the issue of disparity of marks distributions among the different boards. Option 2 uses a linear transformation of the aggregate scores to bring parity in the average value and the spread of scores across various boards. A variation of this method is currently used for admission to engineering colleges in the state of Kerala. However, even after this transformation, the scores from different boards continue to have different distributions. This difference can only be removed by a nonlinear transformation that brings parity in the aggregate score distributions in the examinations conducted by all the boards. Therefore, Option 2 was discarded in favour of Option 1.

Following these arguments, the Core Committee chose Option 1 as the preferred normalization scheme.

The following are the summary of the Group's deliberations and decisions on some related issues.

Distribution of scores. It is possible to use a further transformation of the percentiles of aggregate scores so that the transformed percentiles have any desired distribution. For example, the suggestion from ACER was to ensure that the transformed percentiles have the normal distribution. It was observed that as such the percentiles have uniform distribution over the range 0 to 100. Any further transformation would cause higher concentration of 'normalized scores' in certain ranges and less concentration in other ranges. Ranges with less concentration of scores would be more amenable to efficient discrimination for selection – at the expense of other ranges. Since the normalized scores would eventually be used for

admission to different engineering colleges catering to a wide variety of students, it was felt that the best possible discrimination over the entire range of scores is desirable. This requirement corresponds to the choice of not transforming the percentiles at all.

Range of scores. In order to make the JEE-Main scores and the board scores comparable in all respects before the 60% and 40% weights are used for combining them, it was decided that the JEE-Main scores would also be replaced by the percentile of a student. Thus, the JEE-Main percentile and the Board examination percentile would be used as normalized score from the two sets of examinations. These normalized scores, as well as the weighted sum of scores, will be in the range 0 to 100.

Scores of different years. Sometimes students passing from school boards in different years compete together for admission to engineering colleges. The score distributions in a particular board vary from year to year. Therefore, it was decided that percentile of a student in a board would be computed with respect to all the students that appeared from that board in that particular year. This will also make the task of computing percentiles easier for the boards.

Smaller boards. It was expressed that the assumption of a common distribution of 'merit' for all the boards in all the years may be problematic for boards with small number of candidates. However, any attempt to rectify the 'problem' (e.g., by pooling scores of different boards and/or different years) would require further assumptions that are difficult to justify. In other words, the solution would be worse than the 'problem'. Therefore, it was decided that the smaller boards would not be treated differently.

Handling revision of board scores. Board scores of some students are modified after review. Modified score of a candidate may have an impact on the percentile of other candidates. In fact, this difficulty is applicable to all the options considered above. It was decided that in the case of any revision of score after a cut-off date (26th June for 2013 admissions) would entail fresh computation of percentile of the candidate concerned, but the percentiles of the other candidates would not be revised. The boards may be asked to provide the revised percentile corresponding to any score revised after the cut-off date. The NIT's would be free to continue their existing policies on revised scores, or devise a new one.

Discrimination against 'good' boards. The Core Committee was informed of an apprehension that students of boards with a historical record of good performance in AIEEE might feel disadvantaged by the new admission criterion. However, the Core Committee felt that there is no possibility of discrimination against the students of these boards. Good performance in AIEEE or JEE-Main may not be an adequate measure of a student's general academic standing, which is sought to be factored in through the percentile in the board examination. The pattern of education and examinations in a particular board may be better aligned (as compared to other boards) with AIEEE, and this may have led to better performance of the students of those boards in AIEEE. Besides, education/examinations in some boards may have more consistent standards than other boards. The students of such boards will continue to benefit from these attributes. However, different levels of performance in AIEEE by students of different boards can never be regarded as proof of higher intrinsic 'merit' of

students of one board compared to another. Any presumption of different 'merit' distributions among students of different boards should attract the burden of proof.

Post-selection performance. It was felt by the members of the Core Committee that any empirical study on the appropriateness of a particular scheme of normalization has to be based on the performance of students in engineering colleges after selection. Such data are not available at the moment. It would be desirable to initiate steps for collecting data on post-selection academic performance and collating that with pre-selection performance (in Boards/JEE-Main) of students, for meaningful analysis.