How normalization of marks will be carried out for CUET-UG held in multiple sessions in the same subject – further explanation?

As we know, CUET-UG has been conducted in 27 different subjects with freedom to the candidates to choose a combination of these subjects. The CUET-UG scores are to be used by several universities across the country for admission to UG programmes. What is important to note that CUET-UG has been conducted over a period of 6 weeks with tests in a given subject held on different days. So naturally the question that arises is how are we going to compare the performance of different students on a common scale since they have written the test in the same subject but on different days. We need to ensure that the admissions are made based on a score that accurately compares the performance of the students.

Unlike CUET-UG, other entrance examinations are limited to fewer subjects. In single session entrance tests, one common statistically established method is to transform the raw marks into a common uniform scale using the percentile method so that the performance of students can be compared to each other.

But in entrance tests such CUET-UG since the test is conducted on different days and in multiple sessions for the same subject, it will give rise to multiple percentiles for each group of students.

In addition to the above difficulty another problem with using only percentiles is that in subjects such as Sports or Fine Arts, some weightage (e.g. 25%) is given to the skill component by some universities. But, addition of raw marks in the skill component and the remaining weightage (75%) of percentile cannot be done to prepare the rank list because it would be similar to adding oranges to apples.

A solution to this situation is the use of a method called the equipercentile method. In this method, percentile for each candidate is calculated using the raw marks of the candidate as compared to the raw marks of others in the same session. This is done for every session across multiple days for the same subject. These percentiles are then equated, and converted into normalised marks. For sessions with smaller number of candidates, these are clubbed with bigger sessions.

In the equipercentile method, we use the same scale for all candidates independent of in which session they have appeared in a given subject making their performance comparable across sessions. These normalized marks of the candidates, obtained using equipercentile method, in different sessions in a given subject can be used in the same way we use the raw marks of a conventional single session examination. Therefore, in a particular university, if the raw marks of the skill component has certain weightage (e.g. 25%), it can be added to the remaining weightage (e.g. 75%) of the normalized marks to prepare the rank list. What is important to note here is that for each subject for which examination is held in multiple shifts, raw marks are converted into normalised marks on a common scale.

Let us now see how these normalized marks are calculated on a common scale using the equipercentile method in a given subject. This involves four steps.

Step 1: Using raw marks of the students in different shifts, calculate the percentiles of students in each shift.

To calculate the normalized marks across different sessions in a given subject, first we need to find the percentile of each group of these students for each shift using the raw marks they have scored.

Let us say in a given shift, 100 students have appeared for the test. We sort their marks in decreasing order. Let us assume that one student among these 100 students has scored 87 % marks. Now let us assume that 80 out 100 students have secured less than or equal to 87% marks. The percentile of this student with 87% marks would be 80/100=0·8. The percentile so calculated will always be between 0 and 1 and it is usually rounded off to the requisite number of decimal places.

Step 2: Arrange these percentiles in a descending order by noting the raw marks of the students in each shift.

Let us now assume that there are six students (Stu1,Stu2,Stu3,Stu4,Stu5,Stu6). Three of them (Stu2,Stu4,Stu6) have taken the test in shift-1 and the remaining (Stu1,Stu3,Stu5) in shift-2 but all in the same subject. Using the raw marks of these students, first the percentiles (P_{Stu1} ,P_{Stu2} ,P_{Stu3} ,P_{Stu4} ,P_{Stu5} ,P_{Stu6})of these six students in a given subject are calculated and are sorted in a decreasing order. TheirRaw Marks (RM_{Stu1}, RM_{Stu2} , RM_{Stu3}, RM_{Stu4}, RM_{Stu5}, RM_{Stu6})in the test in each shift are also noted corresponding to their percentiles.

Let us assume that the percentiles in the descending order are as follows:
$P_{Stu5} > P_{Stu2} > P_{Stu1} > P_{Stu4} > P_{Stu6} > P_{Stu3}$

Student	Percentile	Raw Marks in shift-1	Raw marks in shift-2
Stu5	P_{Stu5}	Blank	RM_{Stu5}
Stu2	P_{Stu2}	RM_{Stu2}	Blank
Stu1	P_{Stu1}	Blank	RM_{Stu1}
Stu4	P_{Stu4}	RM_{Stu4}	Blank
Stu6	P_{Stu6}	RM_{Stu6}	Blank
Stu3	P_{Stu3}	Blank	RM_{Stu3}

Step 3: Using linear interpolation, calculate the marks of the students in the above blanks in the table

Since some students (Stu2,Stu4,Stu6) have attended shift-1 and not shift-2, their raw marks in the shift-2will not be present. Similarly the students (Stu1,Stu3,Stu5) who wrote the exam in shift-2, will have no marks in shift-1. These missing marks of each candidate in each shift are then calculated using a method called interpolation. Interpolation is a mathematical way of estimating missing marks of the students who are absent in one shift because they have already taken the test in the other shift. The

Interpolated Marks (IM_{Stu1} , IM_{Stu2} , IM_{Stu3} , IM_{Stu4} , IM_{Stu5} , IM_{Stu6})of the students are now shown in the table below.

Student	Percentile	Marks in shift-1	Marks in shift-2
Stu5	P_{Stu5}	IM_{Stu5}	RM_{Stu5}
Stu2	P_{Stu2}	RM_{Stu2}	IM_{Stu2}
Stu1	P_{Stu1}	IM_{Stu1}	RM_{Stu1}
Stu4	P_{Stu4}	RM_{Stu4}	IM_{Stu4}
Stu6	P_{Stu6}	RM_{Stu6}	IM_{Stu6}
Stu3	P_{Stu3}	IM_{Stu3}	RM_{Stu3}

Step 4: Calculate the normalized marks for each student on a common scale.

Using the above method, each percentile value of the candidates sorted in a descending order will have marks for both shifts, raw marks and interpolated marks. Raw marks are available in the shift where the student has written test and interpolated marks are estimated in the other shift because the student could not have written test for a second time in the same subject. For each student, we then calculate the average of the actual raw marks in one shift and the marks obtained using interpolation in the other shift. This will give the normalized marks for the corresponding percentile of each candidate as shown below.

Student	Percentile	Marks in shift-1	Marks in shift-2	Normalized marks
Stu5	P_{Stu5}	IM_{Stu5}	RM_{Stu5}	$(IM_{Stu5}+ RM_{Stu5})/2$
Stu2	P_{Stu2}	RM_{Stu2}	IM_{Stu2}	$(RM_{Stu2} + IM_{Stu2})/2$
Stu1	P_{Stu1}	IM_{Stu1}	RM_{Stu1}	$(IM_{Stu1}+ RM_{Stu1})/2$
Stu4	P_{Stu4}	RM_{Stu4}	IM_{Stu4}	$(RM_{Stu4}+ IM_{Stu4})/2$
Stu6	P_{Stu6}	RM_{Stu6}	IM_{Stu6}	$(RM_{Stu6}+ IM_{Stu6})/2$
Stu3	P_{Stu3}	IM_{Stu3}	RM_{Stu3}	$(IM_{Stu3}+ RM_{Stu3})/2$

This method has been shown to be accurate for estimating normalized marks of candidates when the tests are held in multiple sessions with varying difficulty levels in a given subject.

The score card of a candidate will have percentiles and normalised marks. Universities need to use the normalized marks given in the score card for preparing the ranking list for admissions.

The above method is based on the work:
“Normalization of marks in multi-session examinations”, Abhay G. Bhatt et al, CURRENT SCIENCE, VOL. 118, NO. 1, 10 JANUARY 2020.