Ministry of Railways

Railway Recruitment Boards

Normalization of Marks in CBT2 under CEN 01/2018: A Scientific and Statistical Process

1.0, RRB examinations attract exceptionally large number of candidates. In order to conduct examination for such a large number of candidates, examination has to be held in multiple sessions. Accordingly, 2nd stage CBT was held in 10 sessions. CBT Marks are normalized in all the stages of exam and the instructions in this regard have been clearly mentioned in para 6 of CEN 01/2018.

2.0 When an examination is conducted in multiple sessions for the same syllabus, in spite of all efforts there are chances of variation in the difficulty level of the questions in various sessions. Thus the score obtained by the candidates of same calibre is likely to vary. In order to equalize the variation in the difficulty level of question papers a process called statistical normalization of marks is resorted to universally. This ensures level playing field for all the candidates.

3.0 Normalization process followed by RRBs is a scientific and statistical process. It is not a process of awarding grace marks.

The normalisation formula used by RRBs is as under:

Xn= (S2/S1) (X-Xav) + Yav Where
Xn= Normalised Score of a Candidate
S2— Standard Deviation of raw marks of Base Session
S1= Standard Deviation of raw marks of Candidate Session
X= Raw marks of candidate which is to be normalized
Xav= Average of raw marks of Candidate Session
Yav= Average of raw marks of Base Session

Base Session is a Session having highest average among all the Sessions of an exam with a condition that its population should be 70% or more than the average of all Session.

3.1. The process involves raw score of the candidate, mean and standard deviation of raw marks of candidates in his/her session as well as other sessions being normalized.

The Raw Score is computed as under:

Total Questions-100;
No of Questions Ignored (on account of question wrong, multiple options correct etc): 2
No of Questions attempted: 60; Correctly Answered: 54; Wrongly Answered: 6
Positive Marks: 54; Negative Marks: 2; Net Score: 54-2=52
Score Out of 100: (52/98)*100= 53.06

3.2 In the statistical process, statistical parameters of a session e.g. mean marks and standard deviation of marks scored by the candidates in the session are analysed and based on the calculated values of these parameters a session is taken as base session (highest mean marks amongst the sessions). The normalization is carried out with respect to this base session so as to equalize the difficulty level of all other sessions to this session. In the base session, there will be no change to the score as the normalized marks will be same as the raw marks of this session **(Please see Example 5 below).**

4.0 **Some examples to illustrate the process**

Considering an examination conducted in 10 sessions, the statistical parameters of the sessions are as under:

Sessio No	Mean of Raw Mark	Standard Deviation of Raw Marks
1	38.20	19.93
2	26.62	14.75
3	26.45	16.37
4	25.94	15.16
5	27.37	15.18
6	32.05	15.82
7	38.32	18.32
8	21.31	12.68
9	33.02	17.61
10	37.00	20.27

Session No 7 is taken as base session based on the mean of raw marks, **which is the highest amongst the sessions.**

Example 1: Consider a candidate of **Session 6,** whose **raw marks are 90.**

So here S2= 18.32, S1= 15.82, Xav= 32.05, Yav= 38.32, X= 90

Applying the formula above the normalized marks would be:

Xn = (S2/S1) (X-Xav) + Yav

= (18.32/15.82)(90-32.05)+38.32

= 105.42771 (normalized marks increases with respect to raw marks)

Example 2: Taking another example of a candidate of **Session 6,** whose **raw marks is 45.**

So here S2= 18.32, S1= 15.82, Xav= 32.05, Yav= 38.32, X= 45

Applying the formula above the normalized marks would be:

Xn = (S2/S1) (X-Xav) + Yav

= (18.32/15.82)(45-32.05)+38.32

= 53. 31646 (normalized marks increases with respect to raw marks)

Example 3: Consider a candidate of **Session 1** whose **raw marks are 55**

So here S2= 18.32, S1= 19.93 Xav= 38.20, Yav= 38.32, X= 55

Applying the formula above the normalized marks would be:

Xn = (S2/S1) (X-Xav) + Yav
= (18.32/19.93)(55-38.20)+38.32

= 53.76285 (normalized marks decreases with respect to raw marks)

Example 4: Consider a candidate of **Session 1** whose **raw marks are 85**

So here S2= 18.32, S1= 19.93 Xav= 38.20, Yav= 38.32, X= 85

Applying the formula above the normalized marks would be:

Xn = (S2/S1) (X-Xav) + Yav

= (18.32/19.93)(85-38.20)+38.32

= 81. 33937 (normalized marks decreases with respect to raw marks)

Example 5: Consider a candidate of **Session 7** whose **raw marks are 40**

So here S2= 18.32, S1= 18.32, Xav= 38.32, Yav= 38.32, X= 40

Applying the formula above the normalized marks would be:

Xn = (S2/S1) (X-Xav) + Yav

= (18.32/18.32)(40-38.32)+38.32

= 40 (i.e. No change)

Example 6: Consider a candidate of **Session 9** whose **raw marks are 63**

So here S2= 18.32, S1= 17.61, Xav= 33.02, Yav= 38.32, X= 63

Applying the formula above the normalized marks would be:

Xn = (S2/S1) (X-Xav) + Yav

= (18.32/17.61)(63-33.02)+38.32

= 69.50873 (normalized marks increases with respect to raw marks)

Example 7: Consider a candidate of **Session 10** whose **raw marks are 73**

So here S2= 18.32, S1= 20.27, Xav= 37.00, Yav= 38.32, X= 73

Applying the formula above the normalized marks would be:

Xn = (S2/S1) (X-Xav) + Yav

= (18.32/20.27)(73-37.00)+38.32

= **70.85674** (normalized marks decreases with respect to raw marks)

Example 8: Consider a candidate of **Session 10** whose **raw marks are** 38

So here S2= 18.32, S1= 20.27, Xav= 37.00, Yav= 38.32, X= 38

Applying the formula above the normalized marks would be:
Xn = (S2/S1) (X-Xav) + Yav

= (18.32/20.27)(38-37.00)+38.32= 39.22799 (normalized marks increases with respect to raw marks)

5.0 **Conclusion from above illustration**

5.1 Increase/decrease of one candidate may differ from increase/decrease of another candidate in the same session as the raw score is also one of the parameters in the calculation which is different for different candidates.

5.2 Normalized marks can decrease for one candidate and increase for another candidate in the same session as illustrated in example 7 and 8 above.

5.3 The variation in Normalised marks of a candidate depends on the average of the candidate shift, score of the candidate, standard deviation of the candidate shift, Base shift with highest Average and the Standard deviation of the Base shift.

5.4 In the normalization process, candidates may score marks higher than 100 in case of very good performers in the difficult session (See Example 1 above). Consider a candidate who had appeared in the most difficult session and yet scored very high marks say 90. In the process of normalization, the candidates of this session generally have increase in the marks as we equalise the difficulty level of this session as compared to the base session. So a few high performer in the difficult session, such as the candidate Example 1 may get normalized marks over 100 also.

Date: 27-04-2019 **Chairpersons**

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