Mean Standard Deviation Method For Score Normalization

The Soil and Water Conservation department exam was held in multiple shifts from 14th to 16th Jul'24. When an examination is conducted in multiple shifts 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.

Normalization of scores ensures that the marks accurately reflect the candidates' performance relative to the difficulty of the exam in every Shift. The mathematical process of normalization leads to increase or decrease of marks.

$$\widehat{M}_{ij} = \frac{\overline{M}_t^g - M_q^g}{\overline{M}_{ti} - M_{iq}} \left(M_{ij} - M_{iq}\right) + M_q^{gm}$$

$\widehat{M}_{ij}$ = Normalized marks of jth candidate in the ith shift.

$\overline{M}_t^g$ = is the average marks of the top 0.1% of the candidates considering all shifts (No. of candidates will be rounded-up)

M_q^g = is the sum of mean and standard deviation marks of the candidates in the paper considering all shifts.

$\overline{M}_{ti}$ = is the average marks of the top 0.1% of the candidates in the ith shift (No. of candidates will be rounded-up)

M_{iq} = is the sum of mean marks and standard deviation of the ith shift

M_{ij} = is the actual marks obtained by the jth candidate in ith shift.

M_q^{gm} = is the sum of mean marks of candidates in the shift having maximum mean and standard deviation of marks of candidates in the examination considering all shifts.

Below is the shift summary for the Soil and Water Conservation department exam held from 14th to 16th July 2024 basis which normalization has been carried out

Date_Shift	**Number of total candidates per shift**	**Mean Value per Shift**	**Standard Deviation Value per shift**	**Average of 0.1% Topper per shift ($\bar{M}_{ti}$)**	**Sum of Mean & Standard deviation per shift (M_{iq})**
14th July 2024 Shift 2	4382	91.97798	27.30376	164	119.28174
14th July 2024 Shift 3	4411	90.21095	29.96715	166.3	120.1781
15th July 2024 Shift 1	4440	74.18592	27.29808	149.1	101.484
15th July 2024 Shift 2	4410	75.69399	26.55534	144.4	102.24933
15th July 2024 Shift 3	4351	74.71604	27.70435	149.8	102.42039
16th July 2024 Shift 1	4430	75.60959	27.93138	152.1	103.54097
16th July 2024 Shift 2	4490	89.45278	29.51986	157.8	118.97264
16th July 2024 Shift 3	4541	77.31777	27.23177	151	104.54954

The normalization formula has some constant value for all the shifts and then mention the calculate constants

$\bar{M}_t^g$ = is the average marks of the top 0.1% of the candidates considering all shifts = 161.27778

M_q^g = is the sum of mean and standard deviation marks of the candidates in the paper considering all shifts = 110.05568

M_{ij} = is the actual marks obtained after objections

M_q^{gm} = is the sum of mean marks of candidates in the shift having maximum mean and standard deviation of marks of candidates in the examination considering all shifts. = 120.89004

Example 1: Calculating Normalizes score of a candidate obtained 105 Marks after objections in 16th July Shift 2

$$\widehat{M}_{ij} = \frac{\overline{M}_t^g - M_q^g}{\overline{M}_{ti} - M_{iq}} \left(M_{ij} - M_{iq}\right) + M_q^{gm}$$

$$\widehat{M}_{ij} = \frac{161.27778 - 110.05568}{157.8 - 118.97264} * (105 - 118.97264) + 120.89004$$

$$\widehat{M}_{ij} = \frac{51.2221}{38.82736} * (-13.97264) + 120.89004$$

$$\widehat{M}_{ij} = 1.31923 * (-13.97264) + 120.89004$$

$$\widehat{M}_{ij} = -18.43308 + 120.89004$$

$$\widehat{M}_{ij} = 102.45696$$

Example 2: Calculating Normalizes score of a candidate obtained 105 Marks after objections in 16th July Shift 3

$$\widehat{M}_{ij} = \frac{\overline{M}_t^g - M_q^g}{\overline{M}_{ti} - M_{iq}} \left(M_{ij} - M_{iq}\right) + M_q^{gm}$$

$$\widehat{M}_{ij} = \frac{161.27778 - 110.05568}{151 - 104.54954} * (105 - 104.54954) + 120.89004$$

$$\widehat{M}_{ij} = \frac{51.2221}{46.45046} * (0.45046) + 120.89004$$

$$\widehat{M}_{ij} = 1.10273 * (0.45046) + 120.89004$$

$$\widehat{M}_{ij} = 0.49673 + 120.89004$$

$$\widehat{M}_{ij} = 121.38677$$