CHAPTER **10** ESTABLISHING NORMS
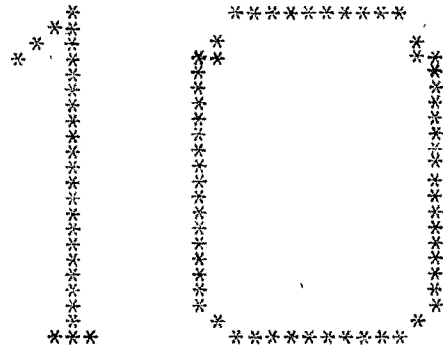

Norming the psychological tests:

Raw scores from different subtests must be converted
into standard units before they are added together.
Secondly a total score so yielded should again be
converted into standard units if they are to be meaningful
in comparison with other test-scores. This is necessary
for purposes of interpretation.

There are two general classes of norms resulting from
such transformation. Reference Norms and statistical norms.
Reference norms include work norms, age-norms and grade norms.
Statistical norms include percentiles, standard scores and
normalised scores.

Reference norms will not be considered here as age-range and grades are fixed forthe group under study.

Statistical Norms

Percentile Norms: If scores are converted into percentiles the resulting distribution will be rectangular. Percentile points can be found from grouped data using formula (Garret: 1969). Often the percentiles shown are P_1, P_5 P_{10} and so on, at intervals of five percentile points upto P_{95} and P_{99} (Dubois: 60, p.413).

Standard Score Norms:

Most popular standard score system used for norming psychological test is of an arbitrary mean of 50 and arbitrary standard deviation of 10. Formula used earlier in a similar instance (Guilford: 112) will be used for converting raw scores into standard scores. Standard score distribution is exactly similar to raw score distribution.

Normalised Scores;

Normalised standard scores are similar to standard scores in that their mean and standard deviation are determined previously. However, the nature of the

distribution of raw scores is considerably altered in the
process of normalising it. If raw score distribution
itself is normal, standard scores and normalised scores
concur with each other.

10.2 Establishing and Interpreting Norms:

Different types of norms have been discussed above
with special reference to statistical norms. Two types of
norms established for the present test are (i) Percentile ·
Norms, (ii) Standard Score Norms.

Sample: Sample for which norms have been established
consists of 450 X std., children from eight different schools
of Dharwar and Udipi. Table (21) gives the mean and S.ds
of the constituents of C.C.I. based on this sample.

A study of the distribution: A frequency distribution
(N=450) of Ss or C.C.I. has been prepared and studied for
deviations from normality. Table 22 gives the frequency
distribution and computation of relevant statistics like
mean, median, s.d., Divergence from normality has been tested
for significance. A graphic display of the frequency
distribution has been presented in Appendix B (Fig. 3).

TABLE 21

Means and standard deviations of the
8 creativity measures (raw)
of the C.C.I. for the
sample N = 450

Test scores	Mean	S.D
A	19.6244	6.1944
C	3.5178	2.2841
D	21.1666	10.8319
G	3.6000	2.4589
H	12.8666	6.7231
I	6.3800	2.7406
J	3.3644	2.9399
K	2.2889	1.7196

TABLE 22

Frequency distribution of 450 Ss. on the standard score sum
(C.C.I.) of 8 creativity measures and computation
of mean S.D and median

Sl. No.	Class Intervals	f	x'	fx'	fx'^{2}	Cum f
1	541–560	1	8	8	64	450
2	521–540	5	7	35	245	449
3	501–520	3	6	18	108	444
4	481–500	17	5	85	425	441
5	461–480	25	4	100	400	424
6	441–460	34	3	102	306	399
7	421–440	48	2	96	192	365
8	401–420	69	1	69 ___ 513	69	317
9	381–400	89	0	0	0	248
10	361–380	78	–1	–78	78	159
11	341–360	46	–2	–92	184	81
12	321–340	22	–3	–66	198	35
13	301–320	11	–4	–44	176	13
14	281–300	2	–5	–10 ___ –290	50	2
		450		223	2495	

TABLE 22

Calculations continued

Mean $= AM + ci$

$\qquad = 390.5 + .4955 \times 20$

$\qquad = 400.41$

$c = \dfrac{\Sigma fx'}{N}$

$\qquad = \dfrac{223}{450}$

$\qquad = .4955$

$c^2 = .2455$

Standard deviation $\qquad = i\sqrt{\dfrac{fx'^2}{N} - c^2}$

$\qquad = 20\sqrt{\dfrac{2495}{450} - (.4955)^2}$

$\qquad = 46.04$

Mdn $\qquad = 1 + \dfrac{(N/2 - F)i}{f_m}$

$\qquad = 380.5 + \dfrac{(225 - 159)20}{89}$

$\qquad = \underline{395.34}$

Computation of Measures of Divergence from Normality of

the Distribution based on Normative Sample (N = 450):

1. Skewness:

(a) $Sk = \frac{3 \ (Mean - Median)}{\sigma}$

$= \frac{3 \ (400-41-395.34)}{46.04}$

$= \frac{3 \ (5.07)}{46.04}$

$= .33$

The distribution is positively skewed.

(b) $Sk = (\frac{P_{90} + P_{10}}{2}) - P_{50}$

$= \frac{465.30 + 344.85}{2} - 395.34$

$= \frac{810.15}{2} - 395.34$

$= 405.075 - 395.340$

$= 9.735.$

(Note: Computing percentiles including P_{10}, P_{50} and P_{90} have been given in detail in the appendix G)

The distribution is positively skewed.

The two formula: are different: (a) gives the discrepency between mean and median multiplied by 3 in terms of units and (b) gives the discrepency between the average of P_{90} and P_{10} and median. Both computations indicate that the distribution is slightly positively skewed.

2. Kurtosis:

$$Ku = \frac{Q}{P_{90} - P_{10}}$$

where Q = Quartile deviation

and is equal to $\dfrac{Q_3 - Q_1}{2}$

$$= \frac{\dfrac{Q_3 - Q_1}{2}}{P_{90} - P_{10}}$$

Q_3 and Q_1 being 75th and 25th percentiles.

$$= \frac{\dfrac{P_{75} - P_{25}}{2}}{P_{90} - P_{10}}$$

$$= \frac{\dfrac{429.04 - 368.58}{2}}{465.30 - 344.85}$$

(Note: Necessary percentile points have been obtained from Appendix G where computations have been given in detail.)

$$= \frac{30.23}{120.45}$$

$$= .251.$$

.263 which is the kurtosis value of a formal curve.

The distribution is slightly leptokurtic and the discrepancy seems to be negligible.

Reliability of the Statistics based on Normative Sample:

1. Reliability of the Mean:

$$S.E_M = \frac{\sigma}{\sqrt{N}}$$

where σ is the S.D. of the distribution and N is the number of Ss in the sample.

$$= \frac{46.04}{\sqrt{450}}$$

$$= \frac{46.04}{21.2132}$$

$$= 2.17.$$

The true mean lies between $400.41 \pm 2.58 \times 2.17$ (at 99 percent level of confidence) i.e., 400.41 ± 5.60 are the limits.

2. Reliability of the Median:

$$S.E_{Mdn} = \frac{1.253}{\sqrt{N}}$$

where σ = s.d.

and N = number of Ss.

$$= \frac{1.253 \times 46.04}{\sqrt{450}}$$

$$= \frac{1.253 \quad 46.04}{21.2132}$$

$$= 2.719$$

$$= 2.72$$

The true median lies between $395.34 \pm 2.58 \times 2.719$ (at 99 percent level of confidence) i.e., 395.34 ± 7.0150 (or ± 7.01) are the limits.

3. <u>Reliability of the Standard Deviation</u>:

$$SE = \frac{.71}{\sqrt{N}}$$ where σ = S.D.

and N = number of Ss.

$$= \frac{.71 \times 46.04}{21.2132}$$

$$= 1.541$$

The true standard deviation lies between $46.04 \pm 2.58 \times 1.541$ (at 99 per cent confidence level) i.e., 46.04 ± 3.98 are the limits.

<u>Significance of Skewness</u>:

The deviation of the obtained skewness from zero is 9.735.

$$CR = \frac{Sk}{\sigma_{sk}}$$

and $$\sigma_{sk} = \frac{.5185(P_{90} - P_{10})}{\sqrt{N}}$$

$$= \frac{.5185(465.30 - 344.85)}{\sqrt{450}}$$

$$= \frac{.5185(120.45)}{21.2132}$$

$$= 2.944$$

Hence $$CR = \frac{Sk}{\sigma_{sk}}$$

$$= \frac{9.735}{2.944}$$

$$= 3.31$$

The obtained skewness of 9.735, therefore exceeds

the limits of $\pm$ 2.58 σsk. which determine ·01 level of

significance. Hence the obtained skewness, though not-large,

is significant at .01 level.

Significance of Kurtosis:

The deviation (D) of the obtained Kurtosis of .251 from

that of the normal curve (i.e., 263) is .251 - .263 which

is equal to .012.

$$\text{And } \sigma_{ku} = \frac{2779}{\sqrt{N}}$$

$$= \frac{.2779}{21.2132} = .013$$

$$CR = \frac{D}{\sigma_{ku}}$$

$$= \frac{-012}{013} = -.923$$

The obtained Kurtosis (.251) does not differ significantly

from that of the normal curve (i.e., 263) and is within

$\pm$ 1.96 σ_{ku} which are limits at 05 level.

10.3 Discussion and Interpretation of Distribution Statistics:

The statistics σ = 46.04 indicates that the total

variance has remained unchanged. In the case of factor

analysis sample (N=230) σ = 45.82. This is possible

when eight scores of the C.C.I. covary among themselves in

a similar fashion in the two samples viz., 230 Ss and 450 Ss.

Another point of considerable significance is the tolerable (though significant) skewness and not significant kurtosis of the distribution inspite of the fact that some of the individual distributions seemed to be either skewed or kurtic. Probably, Multiple scores (as is the present case), consistently maintain certain relationship among themselves. Total distribution is normal and needs no normalisation.

Standard Score Norms: Conversion of each of the eight raw scores distribution ($N = 450$) into distributions of mean = 50 and s.d. = 10 has been done in the manner adopted earlier at the final study stage. The conversion table has been given under the head of "Norms" in Table 23, Norms A. Total of the eight standard scores for any S gives C.C.I. for that S.

For purposes of easy interpretation the C.C.I.s (=standard score sums) have been converted into standard scores having a distribution with mean of 50 and s.d. 10. The standard score equivalent of C.C.I.'s will be called hereafterwards as Standard C.C.I.'s. As the C.C.I.'s have a large range, range for each standard score has been given in terms of C.C.I. intervals in the Table 24 Norms B.

Table of conversion for the individual score distribution should be used skeptically. Some may feel that some of the

TABLE 23

Norms A   Conversion Table: Standard score equivalents of the 8-CRM measures (raw) of the C.C.I.

A						C			
Raw	Std	Raw	Std	Raw	Std		Raw	Std	Raw	Std
45	90	29	65	14	41		20	122	5	56
44	89	28	64	13	39		19	117	4	52
43	88	27	62	12	38		18	113	3	48
42	86	26	60	11	36		17	109	2	43
41	85	25	59	10	34		16	105	1	39
40	83	24	57	9	33		15	100	0	35
39	81	23	55	8	31		14	96		
38	80	22	54	7	30		13	92		
37	78	21	52	6	28		12	87		
36	76	20	51	5	26		11	83		
35	73	19	49	4	25		10	78		
33	72	18	47	3	23		9	74		
32	70	17	46	2	22		8	70		
31	68	16	44	1	20		7	65		
30	67	15	43	0	18		6	61		

TABLE 23

Norms A Conversion Table: Standard score equivalents of the
8 - CRM measures (raw) of the C.C.I.
(Continued)

					D				
Raw	Std	Raw	Std	Raw	Std	Raw	Std	Raw	Std
70	95	54	80	37	65	21	50	5	35
69	94	52-3	79	36	64	20	49	4	34
68	93	51	78	35	63	19	48	3	33
67	92	50	77	34	62	18	47	2	32
66	91	49	76	33	61	17	46	1	31
64-5	90	48	75	32	60	16	45	0	30
63	89	47	74	31	59	15	44		
62	88	46	73	30	58	14	43		
61	87	45	72	29	57	12-3	42		
60	86	44	71	28	56	11	41		
59	85	43	70	27	55	10	40		
58	84	42	69	25-6	54	9	39		
57	83	41	68	24	53	8	38		
56	82	40	67	23	52	7	37		
55	81	38-9	66	22	51	6	36		

(Continued on the next page)

TABLE 23

Norms A   Conversion Table: Standard score equivalents of the
8 - CRM measures (raw) of the C.C.I.
(Continued)

G				H					
Raw	Std	Raw	Std	Raw	Std	Raw	Std	Row	Std
25	137	10	76	40	90	25	68	10	46
24	133	9	72	39	89	24	67	9	44
23	129	8	68	38	87	23	65	8	43
22	125	7	64	37	86	22	64	7	41
21	121	6	60	36	84	21	62	6	40
20	117	5	56	35	83	20	61	5	38
19	113	4	52	34	81	19	59	4	37
18	108	3	48	33	80	18	58	3	35
17	104	2	43	32	78	17	56	2	34
16	100	1	39	31	77	16	55	1	32
15	96	0	35	30	75	15	53	0	31
14	92			29	74	14	52		
13	88			28	73	13	50		
12	84			27	71	12	49		
11	80			26	80	11	47		

TABLE 23

Norms A   Conversion Table: Standard score equivalents of the
8 - CRM measures (raw) of the C.C.I.
(Continued)

I			J				K	
Raw	Std		Raw	Std	Raw	Std	Raw	Std
14	78		18	100	3	49	8	83
13	74		17	96	2	45	7	77
12	71		16	93	1	42	6	72
11	67		15	90	0	39	5	66
10	63		14	86			4	60
9	60		13	83			3	54
8	56		12	79			2	48
7	52		11	76			1	43
6	49		10	73			0	37
5	45		9	69				
4	41		8	66				
3	38		7	62				
2	34		6	59				
1	30		5	56				
0	27		4	52				

TABLE 24

Norms B: Standard C.C.I. equivalents for the C.C.I.s

C.C.I	Standard C.C.I	C.C.I	Standard C.C.I	C.C.I	Standard C.C.I	C.C.I	Standard C.C.I
560–563	85	477–480	67	394–397	49	311–315	31
555–559	84	472–476	66	389–393	48	307–310	30
550–554	83	468–471	65	384–388	47	302–306	29
546–549	82	463–467	64	380–394	46	297–301	28
541–545	81	458–462	63	376–379	45	293–296	27
537–540	80	454–457	62	371–375	44	288–292	26
532–536	79	449–453	61	366–370	43	284–287	25
527–531	78	445–448	60	362–365	42	279–283	24
523–526	77	440–444	59	357–361	41	274–278	23
518–522	76	435–439	58	353–356	40	270–273	22
514–517	75	431–434	57	348–352	39	265–269	21
509–513	74	426–430	56	343–347	38	260–264	20
504–508	73	421–425	55	339–342	37	256–259	19
500–503	72	417–420	54	334–338	36	251–255	18
495–499	71	412–416	53	330–333	35	247–250	17
491–494	70	408–411	52	325–329	34	242–246	16
486–490	69	403–407	51	320–324	33	238–241	15
481–485	68	398–402	50	316–319	32		

distribution may vary from sample to sample. If it is found
by inspection of means and s ds that obtained scores
distributions differ substantially from the ones given in
the conversion table, it is better to convert them into
standard scores on the basis of obtained means and s.ds
and use of conversion table be dropped. But for obtaining
standard C.C.I. norms table can well be used in all such
encounters.

Essential Considerations in Interpretation of Norms:

Standard Scores: In a standard score system:-

1. Scores in different variables have the same
length or units.

2. Scores can be interpreted with respect to mean
and s.d. assigned to the distribution.

3. All differences in standard scores are directly
proportional to raw scores.

In the present case standard score distribution almost
coincides with normalised distribution, as the obtained
distribution for the total score (C.C.I.) is itself normal.

Percentiles: Unlike standard scores, differences
in percentiles are not proportional to differences in raw
scores. The distribution is rectangular and each percentile
point adds the same number of individuals to the group which

TABLE 25

Norms C: Percentiles

Percentile	C.C.I	Standard C.C.I
P_0	280.50	24
P_5	329.14	34
P_{10}	344.90	38
P_{15}	354.60	40
P_{20}	362.90	42
P_{25}	368.58	43
P_{30}	374.40	44
P_{35}	380.30	46
P_{40}	385.20	47
P_{45}	390.30	48
P_{50}	395.30	49
P_{55}	400.30	50
P_{60}	406.90	51
P_{65}	413.30	53
P_{70}	419.90	54
P_{75}	428.62	56
P_{80}	437.80	58
P_{85}	450.70	61
P_{90}	465.30	64
P_{95}	484.62	68
P_{100}	560.50	85

TABLE 26

Creativity Levels and Percentile Points

Percentile Points	CCI Scores	Standard CCI	Creativity Levels
Above P_{80}	438 and above	58 and above	A. Always Creative
Between P_{60} and P_{80}	408–437	52–57	B. Above Average
Between P_{40} and P_{60}	386–407	47–51	C. Average
Between P_{20} and P_{40}	363–385	42–46	D. Below Average
Below P_{20}	362 and below	41 and below	E. Never Creative

the individual obtaining the previous percentile point
supersedes. For example an individual boy scoring 465.30
or getting standard C.C.I. of 64 supersedes 90 per cent
of the boys in his groups. An individual scoring 465.70 or
a standard C.C.I. of 61 supersedes 85 per cent of the boys in
his group. An individual getting a standard C.C.I. of 58
(or 437.80 in C.C.I.) stands higher than the 80 per cent of
the individuals in his group in creativity. Then each 5
percentile point in the ascending order adds 5 per cent of
the group to the group superseded by any individual boy or
girl getting or standing at that point. Table 26 gives
different levels of creativity associated with percentile points.
This has been given for the sake of easy interpretation.