we form the following table for cumulative frequencies

Table 3.3

Calculation for determination of missing frequencies

Marks	No. of students (frequency)	Cumulative frequency (< type)
0-10	10	10
10-20	f_1	$10+f_1$
20-30	25	$35+f_1$
30-40	30	$65+f_1$
40-50	f_2	$65+f_1+f_2$
50-60	10	$75+f_1+f_2$
Total	100	—

Here median = 32. Hence the class interval 30-40 contains the median

Again, $n=100$, so that

$$75+f_1+f_2=100 \text{ or } f_1+f_2=25 \quad \text{---(i)}$$

Now median $= l + \dfrac{\frac{n}{2}-F_l}{f_{Me}} \times c$, symbols having usual meanings

or, $$32 = 30 + \frac{\frac{100}{2}-(35+f_1)}{30} \times 10$$

or, $$2 = \frac{50-35-f_1}{3}$$

or, $6 = 15-f_1$ or, $f_1 = 9$

So, from (i), $f_2 = 25-9 = 16$

(ii a) Other positional measures — Quartiles

Before describing quartiles, we define a measure, called quantiles. The quantile (or fractile) of order p is that value of the variable which is such that a portion p of the total number of given values are less than or equal to it and the rest are greater than or equal to it. In the case of grouped frequency distribution, an approximate value of the quantile of order p is given ~~to~~ by the formula

$$Z_p = l + \frac{np - F_l}{f_0} \times c \quad \cdots \text{Eq.}(4a)$$

where l, f_0 and c denote respectively the lower boundary, frequency and width of the class ~~containing~~ containing Z_p, n is the total frequency and F_l is the cumulative frequency of less than type upto l.

In the previous ~~chapt~~ notion, we have defined the median, which $Z_{1/2}$. The three values $Q_1 = Z_{1/4}$, $Q_2 = Z_{1/2}$ and $Q_3 = Z_{3/4}$ which divide the frequency distribution of the variable ~~into~~ into four equal parts are known as Quartiles. Q_1, Q_2 and Q_3

are said to be the first (or the lower) quartile, the second quartile and the third (or the upper) quartile respectively

Example 4.10

Find the values of Q_1, Q_3 from the following data:

Height (in cm.):	141-145	146-150	151-155	156-160	161-165	166-170	171-175
No. of persons:	7	9	15	23	21	10	5

Solution: First we construct the following table:

Table 3.4

Calculation for Q_1, Q_3

Height (in cm)	No. of persons (f)	class boundaries	Cumulative frequency (< type)
141-145	7	140.5 — 145.5	7
146-150	9	145.5 — 150.5	16
151-155	15	150.5 — 155.5	31
156-160	23	155.5 — 160.5	54
161-165	21	160.5 — 165.5	75
166-170	10	165.5 — 170.5	85
171-175	5	170.5 — 175.5	90
Total	9	—	—

Here $n = \sum_i f_i = 90$, $\frac{n}{4} = 22.5$, $\frac{3n}{4} = 67.5$

From the cumulative frequency column of the above table, we find that the class interval 150.5–155.5

and 160.5 – 165.5 respectively contain Q_1 and Q_3.

So, $Q_1 = 150.5 + \frac{22.5 - 16}{15} \times 5 = 150.5 + 2.17$
$= 152.67$ (cm)

$Q_3 = 160.5 + \frac{67.5 - 54}{21} \times 5 = 160.5 + 3.21$
$= 163.71$ (cm)

(iii) Mode

The mode of a variable is that value of the variable which has the highest frequency or frequency density, according as the variable is discrete or continuous. In the latter case, if a unimodal distribution can be fitted with a smooth frequency curve, then the mode is the abscissa of the highest point of the curve.

A distribution can have more than one mode, but if all the values in a distribution have the same frequency or frequency density (as the case may be) then the mode is not defined.

In a given frequency distribution for a discrete variable, the mode can be immediately found by inspection. So, for the discrete ~~distribut~~ distribution in Page-88, 4 is the mode as it has the highest frequency.

For a continuous frequency distribution, modal can be easily picked out and a measure of Mode (M_0) (approximately)