

**Q.1 (a)** The age of a student is normally distributed with mean of 12 years and standard deviation of 4 years. Find the probability that:

i) age of student is at least 20 years

ii) age of student is between 0 and 12 years

[Given  $p(0 \leq z \leq 2) = 0.4772$ ,  $p(0 \leq z \leq 3) = 0.49865$ ]

**Solution:**

Formula:

$$z = (x - \mu) / \sigma$$

Where:

$\mu$  = Mean

$\sigma$  = Standard deviation

i) For  $x = 20$ , the z-value  $z = (20 - 12) / 4 = 2$

Hence  $P(x < 20) = P(z < 2) = 0.4772$

ii) For  $x = 0$ , the z-value  $z = (0 - 12) / 4 = -3$

For  $x = 12$ , the z-value  $z = (12 - 12) / 4 = 0$

Hence  $P(0 < x < 12) = P(-3 < z < 0)$

[When probability lies between a negative and a positive, look up both areas in the z-score table and add them together]

Therefore,

$$P(z < 0) + P(-3 < z) = 0.0000 + 0.4987 = 0.4987$$

**Q.1 (b)** In a frequency distribution of 100 families given below, the number of families corresponding to the expenditure group 20-40 and 60-80 are missing from the table. However the median is known to be 50. Find the missing frequencies.

Expenditure	0-20	20-40	40-60	60-80	80-100
No. of families	14	?	27	?	15

**Solution:**

Let the missing frequencies be  $f_1$  and  $f_2$

Expenditure	No. of families	Cumulative frequency
0-20	14	14
20-40	f1	14+f1
40-60	27	14+f1+27=41+f1
60-80	f2	41+f1+f2
80-100	15	41+f1+f2+15=56+f1+f2
Total families	100	

Sum of missing frequencies = Total – Sum of given frequencies

$$f1 + f2 = 100 - 56$$

$$f1 + f2 = 44$$

$$\text{Median} = L + \frac{\left[\left(\frac{n}{2}\right) - B\right]}{G} * w$$

Where:

L = Lower boundary of group containing median

n = Total number of values

B = Cumulative frequency of group before median group

w = Group width

G = Frequency of median group

By substituting in the formula we get,

$$50 = 40 + \frac{\left[\left(\frac{100}{2}\right) - (14 + f1)\right]}{27} * 20$$

$$50 - 40 = \frac{50 - 14 - f1}{27} * 20$$

$$\frac{50 * 27}{20} = 36 - f1$$

$$f1 = 36 - 13.5$$

$$f1 = 22.5$$

Frequency cannot be in decimal

$$f1 = 23$$

We know that,

$$f_1 + f_2 = 44$$

$$23 + f_2 = 44$$

$$f_2 = 44 - 23$$

$$f_2 = 21$$

The missing frequencies are 23 and 21

