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Subject Probability and Statistics

Date

Q<sup>1</sup> No Students were asked how long it took them to walk to school on a particular morning. A cumulative frequency distribution was formed.

Time taken (in minutes)	< 5	< 10	< 15	< 20	< 25	< 30	< 35	< 40	< 45
frequency	25	45	81	143	280	349	374	395	400

a) Draw a cumulative frequency curve and estimate how many students took less than 18 minutes.

b) Take equal class intervals of 0-5, 10 etc. Construct frequency distribution and draw a histogram.

Solution :-

Class	f	c.B	c.f	<f>
0-4	25	4.5	25	2092
5-9	45	4.5-9.5	70	2067
10-14	81	9.5-14.5	151	2022
15-19	143	14.5-19.5	294	1941
20-24	280	19.5-24.5	574	1798
25-29	349	24.5-29.5	923	1518
30-34	374	29.5-34.5	1297	1669
35-39	395	34.5-39.5	1692	795
40-44	400	39.5-44.5	2092	400

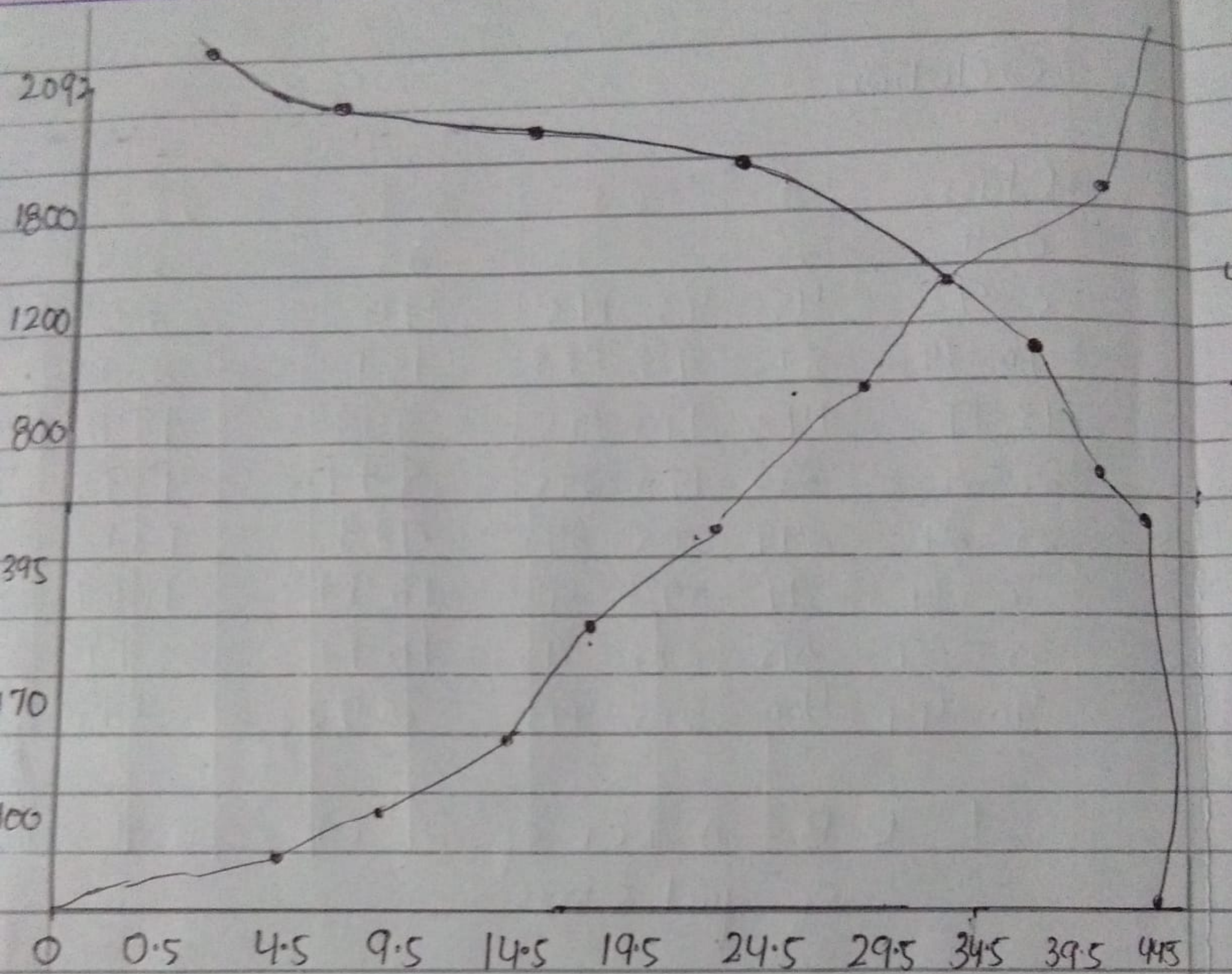
C.B =  $\Delta$  = LCL of 2<sup>nd</sup> class - ucl of first class.

$$C.B = 5 - 4$$

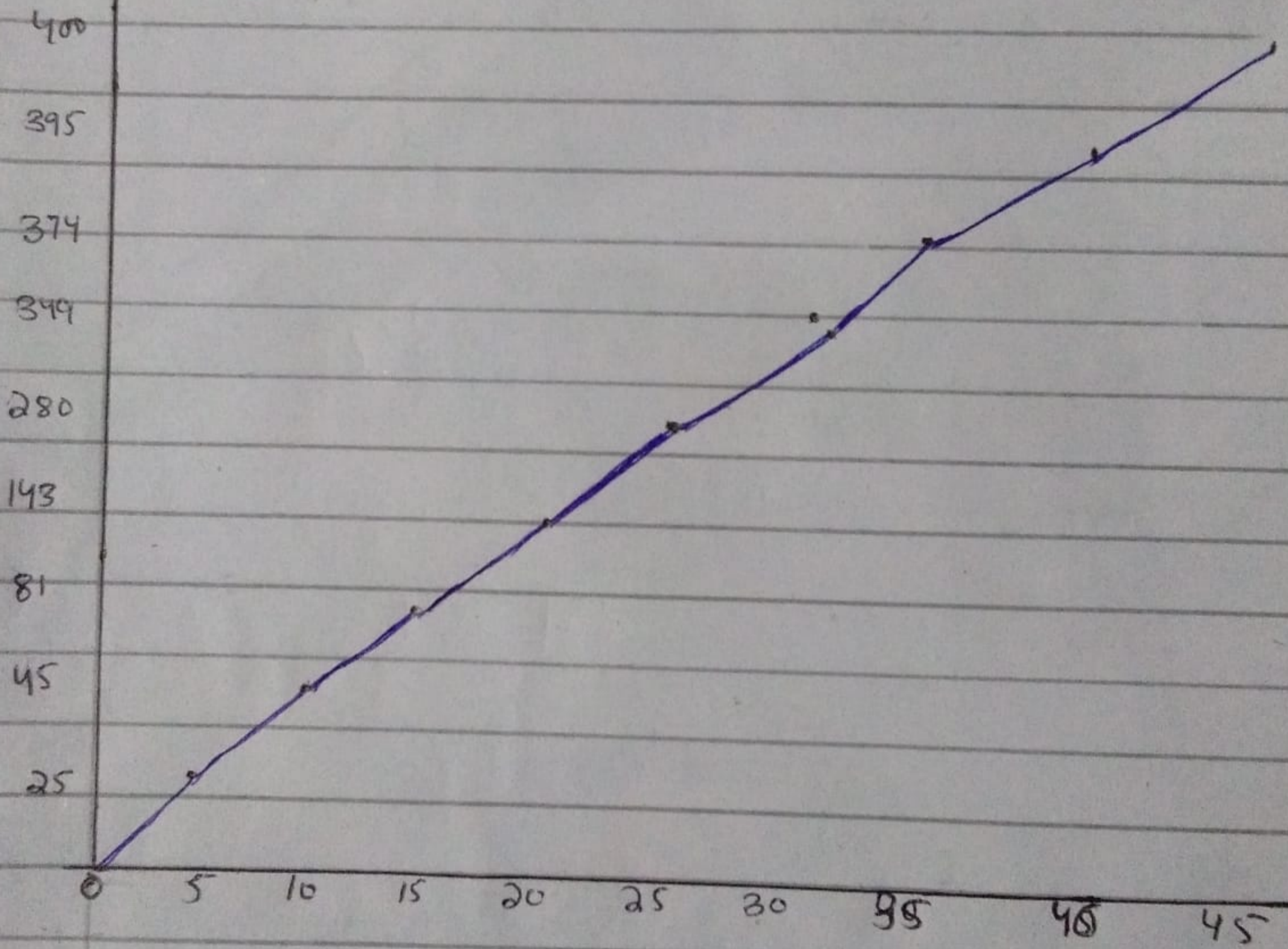
$$C.B = \frac{1}{2}$$

$$C.B = 0.5$$

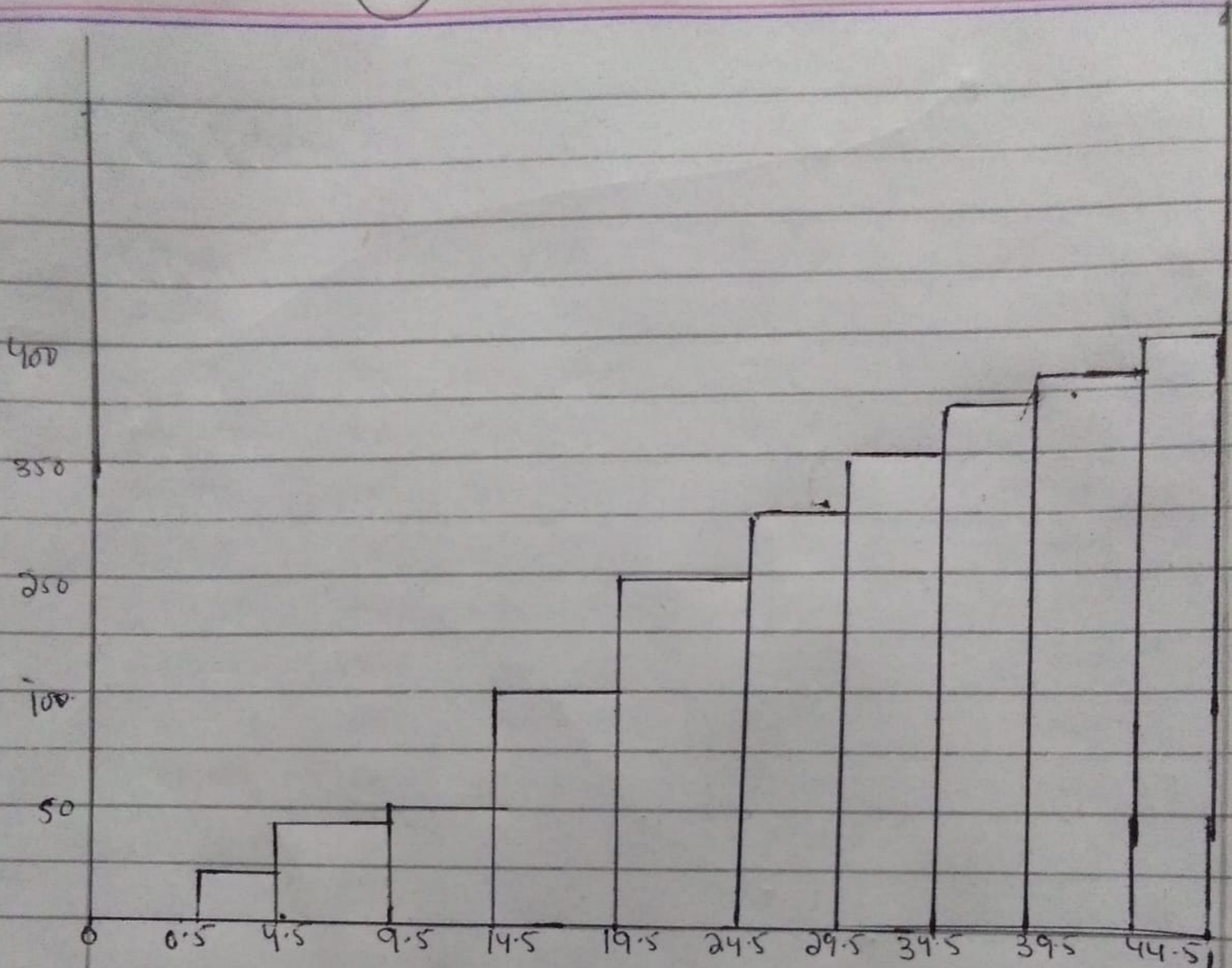
(a)



(9)



(b)



Q2 Construct a grouped distribution table for the following data and calculate Mean, Mode, and Quartiles.

423, 369, 387, 411, 393, 394, 371, 377, 389, 409,  
392, 408, 431, 401, 363, 391, 405, 382, 400,  
381, 399, 415, 428, 422, 396, 372, 410, 419,  
386, 390.

Solution:-

$$N = 30$$

$$X_m = 431$$

$$X_0 = 363$$

Range:-

$$R = X_m - X_0$$

$$R = 431 - 363$$

$$R = 68$$

No of classes:-

$$k = 1 + 3.33 \log(N)$$

$$k = 1 + 3.33 \log(30)$$

$$k = 1 + 3.33 (1.47)$$

$$k = 5.92$$

$$k = 6.$$

$$h = \frac{P}{K}$$

$$\frac{68}{6}$$

$$h = 11.33$$

$$= 12$$

Classes	f	C.B	x	c.f	Tally
363-374	4	362.5-374.5	368.5	4	
375-386	4	374.5-386.5	380.5	8	
387-398	8	386.5-398.5	392.5	16	
399-410	7	398.5-410.5	404.5	23	
411-422	4	410.5-422.5	416.5	27	
423-434	3	422.5-434.5	428.5	30	

Mean:-

$$\bar{x} = \frac{\sum f_i x_i}{\sum f = n}$$

$$\bar{x} = \frac{11919}{30}$$

$$\bar{x} = 397.3$$

Mode:-

$$M = l_1 + \frac{f_1 - f_0}{2 \cdot f_1 - f_0 - f_2} (l_2 - l_1)$$

$$M = 386.5 + \frac{8 - 4}{2(8) - 4 - 7} (398.5 - 386.5)$$

$$M = 386.5 + \frac{4}{16 - 11} (12)$$

$$M = 386.5 + \frac{4}{5} (12)$$

$$M = 386.5 + 9.6$$

$$M = 396.1$$

Quartiles:-

$$q_1 = \frac{n}{4}$$

$$q_1 = \frac{30}{4} = 7.5$$

$$Q_1 = l + \frac{h}{f} (q_1 - c)$$

$$Q_1 = 374.5 + \frac{12}{4} (7.5 - 4)$$

$$Q_1 = 374.5 + 3 (3.5)$$

$$Q_1 = 374.5 + 10.5$$

$$\boxed{Q_1 = 385}$$



$$Q_3 = a + b \frac{q_3 - c}{f}$$

$$Q_3 = 398.5 + 12 \frac{22.5 - 16}{7}$$

$$Q_3 = 398.5 + 12 \frac{6.5}{7}$$

$$Q_3 = 398.5 + 11.14$$

$$Q_3 = 409.64$$

$$q_3 = \frac{3n}{4}$$

$$q_3 = \frac{3(30)}{4}$$

$$q_3 = \frac{90}{4}$$

$$q_3 = 22.5$$

Q3) By multiplying each of the numbers 3, 6, 2, 1, 7, 5 by 2 and then adding 5. We obtain 11, 17, 9, 7, 19, 5. What is the relation between the standard deviation and the means of two sets

Sol:-

First set :- 3, 6, 2, 1, 7, 5

Second set :- 11, 17, 9, 7, 19, 5

First set:- 3, 6, 2, 1, 7, 5

Mean =  $\frac{\text{Sum of numbers}}{\text{total no}}$

$$\text{Mean} = \frac{3+6+2+1+7+5}{6}$$

$$\text{Mean} = \frac{24}{6}$$

$$M = 4$$

$$S.D = \sqrt{\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2}$$

$$S.D = \sqrt{\frac{124}{6} - \frac{576}{36}}$$

$$S.D = \sqrt{\frac{744 - 576}{36}}$$

$$= \sqrt{\frac{168}{36}}$$

$$S.D = \sqrt{4.67}$$

$$S.D = 2.16$$

$x$	$x^2$
3	9
6	36
2	4
1	1
7	49
5	25
<u>24</u>	<u>124</u>

Second set:- 11, 17, 9, 7, 19, 15

$$\text{Mean} = \frac{11 + 17 + 9 + 7 + 19 + 15}{6}$$

$$\text{Mean} = \frac{78}{6}$$

$$\boxed{M = 13}$$

$$S.D = \sqrt{\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2}$$

$$S.D = \sqrt{\frac{1126}{6} - \frac{6084}{36}}$$

$$S.D = \sqrt{\frac{6756 - 6084}{36}}$$

$$= \sqrt{\frac{672}{36}}$$

$$= \sqrt{18.67}$$

$$S.D = 4.32$$

First ~~A~~ Set Mean = 4

S.D of first set = 2.16

2nd set of Mean = 13

S.D of Second set = 4.32

Mean and S.D of 2nd set is greater than first set.

$x$	$x^2$
11	121
17	289
9	81
7	49
19	361
15	225

Q4) For the following grouped distribution table calculate the variance and standard deviation.

Class	64-84	85-104	105-124	125-144	145-164	165-184	185-204
frequency	15	18	27	10	6	5	13

Sol:-

Class	$f_i$ frequency	$x_i$	$f_i x_i$	$x^2$	$f_i x^2$
64-84	15	74	1110	5476	82140
85-104	18	94.5	1701	8930.25	160744.5
105-124	27	114.5	3091.5	13110.25	353976.75
125-144	10	134.5	1345	18090.25	1809102.5
145-164	6	154.5	927	23870.25	143221.5
165-184	5	174.5	827.5	30450.25	152251.25
185-204	13	194.5	2528.5	37830.25	491793.25
	$\Sigma f_i = 94$		11530.5		1565029.75

$$\sigma^2 = \frac{\Sigma f_i x^2}{n} - \left( \frac{\Sigma f_i x}{n} \right)^2$$

$$s^2 = \frac{1565029.75}{94} - \left( \frac{11,575.5}{94} \right)^2$$

$$s^2 = \frac{1565029.75}{94} - \frac{133,992,200.25}{8,836}$$

$$s^2 = 16649.25 - 15,164.35$$

$$s^2 = 1484.9$$

For standard deviation taking square root on b.s

$$\sqrt{s^2} = \sqrt{1484.9}$$

$$s = 38.54$$

Q5 Comment on the following sentences.

a) The depth of a river at four different points is 2, 7, 5, 6 feet respectively. The average depth is 5 feet. Therefore all the people with heights 5 feet can cross it.

Ans) No, if average depth of river is 5 feet then it is not obvious that all the people of height 5 feet cross it. If he cannot swim, he will drown. The important fact is that a river of average depth of 5 feet is not deep uniformly. It is 2 feet at some point while 7 feet at other point. So the 5 feet person can drown when he goes to part of river, that is 6 feet or 7 feet deep.

b) The average marks of one class of students are 30. Therefore every student is hopeless.

Ans) No, it does not mean every student is hopeless. There ~~sho~~ would be students whose marks are less than 30 while there can be few students whose marks might be 60 or more,

So from average marks we cannot  
say every student is hopeless.

c) The average income of a king and his household servants is £20,000 per month, therefore all the household servants must be fabulously paid.

Ans) No, it is not like that, Average pay does not mean everyone get paid same. The king's income will be much more than the servants.