

Chapter 6

Information: To knowledge about some-thing is known as information.

Information Handling: To present information in a manageable way so that useful conclusions can be drawn, is called information handling.

Data: The numerical figures obtained from any field of study are known as data.

Primary Data: The data directly collected from its source is called primary data.

Secondary Data: The data which have been passed through some statistical treatments at-least once is called secondary data.

Constant: Any quantity that has a single value is known as a constant.

Variable: Any characteristic whose values are always different from one individual to another is known as a variable.

Discrete Variable: A variable that can take only some specific values present in the data is called discrete variable.

Continuous variable: A variable that can take every possible value in a given interval (a to b say) is known as continuous variable.

Ungrouped Data: Numerical facts which are obtained on the first hand and recorded as they stand are known as ungrouped data.

Grouped data: The data that have gone through some statistical process

Classification: Classification is a process of arranging the data into certain groups or classes of similar characteristics.

Class Limits: Each class or group is defined by two values, one is small and the other is large. The smaller one is known as the lower class limit and larger one is known as upper class limit.

Width or Length of class interval: The numerical difference between the upper or lower limits of any two consecutive classes is called width or length of class interval.

Class Mark The midpoint of any class is known as class mark.

Class Boundaries: Class boundaries are the actual lower and upper class limits in a class.

Class Frequency; The number of occurrences of items corresponding to the class interval is known as class frequency.

Frequency Distribution: The distribution of data through which items of data are classified into certain groups or classes and the number of items lying in each group or class is put against that group or class is known as Frequency Distribution.

Histogram: Histogram is a graph of adjacent rectangles.

Frequency Polygon: A resulting graph obtained by joining all the midpoints of top sides of rectangles in a histogram is called frequency polygon.

Measure of Location or Center Tendency:

Measure of location is more or the less the central value around which the data appear to be crowded.

Exp1: in a shoe 40 customers bought shoes with following shoe size
6,6,7,6,8,7,7,8,6,10,6,8,8,10,7,9,7,10,6,10,10,9,7,9,6,10,10,7,11,8,8,7,6,6,8,9,7,8,7,9.

Sol: Let Class size = 1

x	Tally mark		f
6		6,6,6,6,6, 6,6,6,6	9
7		7,7,7,7,7 7,7,7,7,7	10
8		8,8,8,8,8 8,8,8	8
9		9,9,9,9	4
10		10,10,10,10,10 ,10,10,10	8
11		11	1
		$\sum f =$	40

Exp2: Height of 30 students of 10th class in cm are as follows. Construct group frequency table
162,165,170,170,162,159,162,163,175,166,171,174,155,160,173,140,145,140,146,150,172,158,155,163,165,171,153,158,149,153.

Sol: Minimum value = 140, Maximum value=175
Range =175-140=35 Let number of groups = 7

Thus width of group = $\frac{175-140}{7} = 5$

Group	Boundaries		f
139-144	138.5-144.5	140,140	2
145-150	144.5-150.5	146,150,149,145	4
151-156	150.5-156.5	155,155,153,153	4
157-162	156.5-162.5	162,162,159,162, 158,158,160	7
163-168	162.5-168.5	165,163,165,163, 166	5
169-174	168.5-174.5	170,170,171,174, 173,172,171	7
175-180	174.5-180.5	175	1
		$\sum f =$	30

Exp3: Construct frequency table of the weight of 30 students are the following table by using 5 as a class interval. Find the class boundaries and class marks also.

25,30,40,21,24,25,36,30,45,50,22,25,36,46,35,38,40,28,34,45,42,46,38,48,28,29,31,33,30,26
Sol: Maximum = 50, minimum = 21

Group	Boundaries		f
21-25	20.5-25.5	25,21,24,25,22,25	6
26-30	25.5-30.5	30,30,30,26,28, 28,29,	7
31-35	30.5-35.5	35,34,31,33	4
36-40	35.5-40.5	40,36,36,38,40,38	6
41-45	40.5-45.5	45,42,45	3
46-50	45.5-50.5	50,46,46,48	4
		$\sum f =$	30

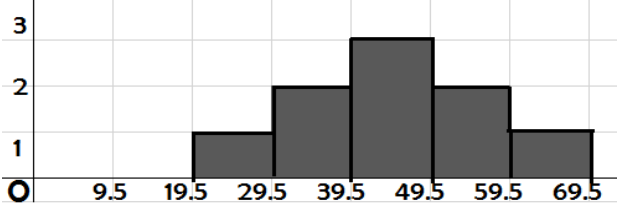
Exp4: Construct a Histogram from the table

Class interval	20-29	30-39	40-49	50-59	60-69
Frequency	1	2	3	2	1

Sol: To draw a histogram class boundaries are marked along x-axis and frequencies of each class are marked along Y-axis

Class Limits	Class Boundaries	Frequency
20-29	19.5-29.5	1
30-39	29.5-39.5	2
40-49	39.5-49.5	3
50-59	49.5-59.5	2
60-69	59.5-69.5	1

Histogram from equal intervals



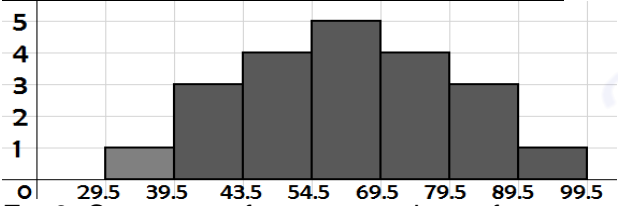
Exp5: Draw Histogram for

Class Limits	30-39	40-43	44-54	55-69	70-79	80-89	90-99
F	10	12	44	75	40	30	10

Sol: Histogram with unequal class intervals. In construction of histogram, we must ensure that area of rectangle are proportional to class frequencies.

Therefore using adjusted frequency = f/h

Limits	Boundaries	h	f	Adjusted Frequency
30-39	29.5-39.5	10	10	1
40-43	39.5-43.5	4	12	3
44-54	43.5-54.5	11	44	4
55-69	54.5-69.5	15	75	5
70-79	69.5-79.5	10	40	4
80-89	79.5-89.5	10	30	3
90-99	89.5-99.5	10	10	1

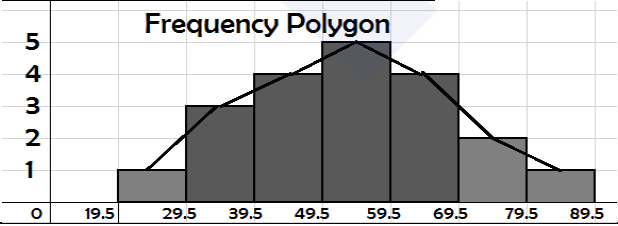


Exp6: Construct a frequency polygon for

Class Limits	20-29	30-39	40-49	50-59	60-69	70-79	80-89
F	1	3	4	5	4	2	1

Sol:

Limits	Boundaries	h	f
20-29	19.5-29.5	24.5	1
30-39	29.5-39.5	34.5	3
40-49	39.5-49.5	44.5	4
50-59	49.5-59.5	54.5	5
60-69	59.5-69.5	64.5	4
70-79	69.5-79.5	74.5	2
80-89	79.5-89.5	84.5	1



Exercise 6.1

Q1: Construct a frequency distribution of the marks of 30 students during a quiz with 100 points by taking 10 as the class interval. Indicate the class boundaries and class marks. 40,60,65,70,35,50,56,74,72,49,85,76,82,83,68,90,67,66,58,46,74,88,76,69,57,63,66,47,82,90. Sol: Maximum marks = 90 Minimum marks=35

Limits	Boundaries	Class marks	Marks	f
35-44	34.5-44.5	40,35	II	2
45-54	44.5-54.5	50,49,46,47,	IIII	4
55-64	54.5-64.5	60,56,58,57,63	IIII	5
65-74	64.5-74.5	65,70,74,72,67,66,74,66,68,69,	IIIIII	10
75-84	74.5-84.5	76,82,83,76,82	IIII	5
85-94	84.5-94.5	85,90,88,90	IIII	4
			$\sum f =$	30

Q2) Following are mistakes made by a group of students of class 10th in a test of essay writing. Using an appropriate size of class interval, make a frequency distribution and also indicate the number of class intervals.

4,7,12,9,21,16,3,19,17,24,14,15,8,13,11,16,15,6,5,8,11,20,18,22,6

Sol: Minimum value= 3, Maximum value = 24

Class size=3 so, no of interval= $(24 - 3)/3 = 7$

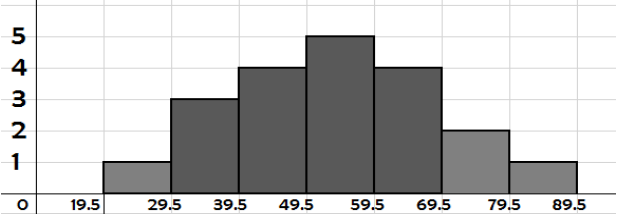
Class interval	Tally	Frequency (f)
3 – 5	3,4,5	3
6 – 8	6,6,7, 8, 8,	5
9 – 11	9, 12, 11, 11,	4
12 – 14	14,15, 13,	3
15 – 17	15, 16, 17, 16,	4
18 - 20	18, 19, 20,	3
22 – 24	21, 24, 22,	3
	$\sum f =$	25

Q3. Draw the histogram for

Limits	20-24	25-29	30-34	35-39	40-44	45-49	50-54
F	1	3	4	5	4	2	1

Sol: For Histogram

Class Interval	Class Boundaries	Number of Person (f)
20-24	19.5-24.5	1
25-29	24.5-29.5	3
30-34	29.5-34.5	4
35-39	34.5-39.5	5
40-44	39.5-44.5	4
45-49	44.5-49.5	2
50-54	49.5-54.5	1



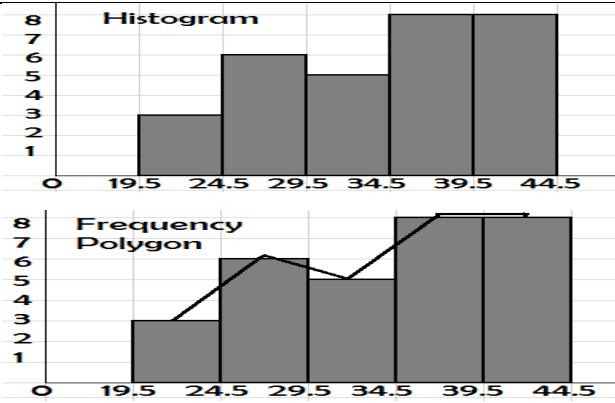
Q4. The following data give the weights in kg of the students in the 10th class.

25,30,32,29,24,40,36,37,28,27,41,42,35,39,31,32,34,42,40,43,36,26,22,23,42,39,35,41,39,29

Sol: Maximum=22 Minimum=43

Choose class size = 5

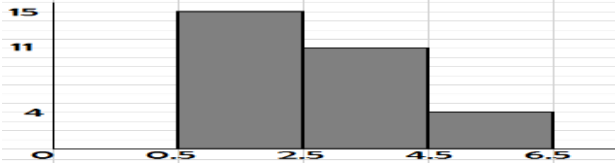
C- Limits	Mid Point	Boundaries	Marks	F
20-24	22	19.5-24.5	24, 22, 23	3
25-29	27	24.5-29.5	25,29,26,29,28,27	6
30-34	32	29.5-34.5	30,32,31,32,34,	5
35-39	37	34.5-39.5	36,37,35,39,36,39,35,39	8
40-44	42	39.5-44.5	40,41,42,41,42,40,43,42,	8



Q5). A teacher asked students about their time spent on homework completion. Following set of data was obtained.4,4,6,3,1,2,2
3,1,4,1,2,5,3,4,5,2,2,3,1,3,1,2,2,3,1,4,2,6,2
Construct a frequency table and draw a histogram showing the results.

Sol: Minimum=1, Maximum=6

C-I	Boundaries	Tally	(f)
1-2	0.5-2.5	1,1,1,1,1, 1, 2,2,2,2,2, 2,2,2,2	15
3-4	2.5-4.5	3,3,3,3,3, 3, 4,4,4,4,4,	11
5-6	4.5-6.5	5, 5, 6, 6,	4
		$\sum f =$	30



Exp7: Find the cumulative frequency of

x	3	4	5	6	7	8	9	10	11	12
f	1	2	3	4	5	6	7	4	3	8

Sol: cumulative frequency table

x	f	Method of finding $c.f$	$c.f$
3	1	1	1
4	2	1+2=3	3
5	3	3+3=6	6
6	4	4+6=10	10
7	5	5+10=15	15
8	6	6+15=21	21
9	7	7+21=28	28
10	4	4+28=32	32
11	3	3+32=35	35
12	8	8+35=43	43

Exp8: The consumption of petrol of 1000cc cars of a particular brand was surveyed. Construct a cumulative frequency distribution

Distancekm	10-12	13-15	16-18	19-21	22-24
Frequency	16	20	36	21	7

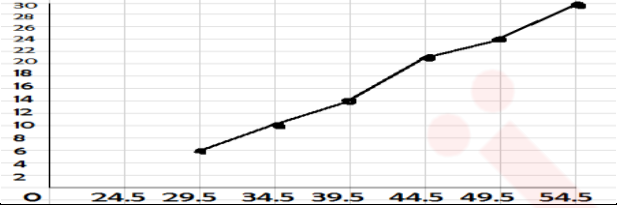
Sol: Cumulative frequency distribution

Mileage	boundaries	Frequency	c.f
10-12	9.5-12.5	16	16
13-15	12.5-15.5	20	36
16-18	15.5-18.5	36	72
19-21	18.5-21.5	21	93
22-24	21.5-24.5	7	100

Exp9: Marks of students are given during first per-board exam of mathematics
25,30,27,28,35,36,40,41,42,45,50,44,29,26,36,
31,43,46,52,53,51,42,37,27,33,46,44,34,51,54
By taking suitable class interval, prepare a

frequency distribution, draw ogive

C limits	Boundaries		f	$c.f$
25-29	24.5-29.5	25,27,28,29,26,27	6	6
30-34	29.5-34.5	30,31,33,34	4	10
35-39	34.5-39.5	35,36,36,37,	4	14
40-44	39.5-44.5	40,41,42,44,43, 42,44,	7	21
45-49	44.5-49.5	45,46,46,	3	24
50-54	49.5-54.5	50,52,53,51,51,54	6	30



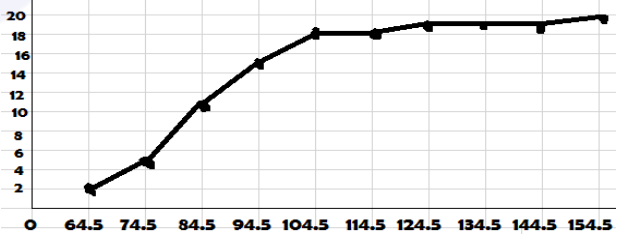
Exercise 6.2

Q1i): Given data shows wages of workers
60,75,80,85,90,84,70,73,76,84,95,100,150,66,
58,90,98,120,77,90.By taking 10 as a class
interval prepare cumulative frequency
distribution.

Sol: Minimum = 58, Maximum = 150

Interval	Boundaries	Marks	f	$c.f$
55-64	54.5-64.5	60,58,	2	2
65-74	64.5-74.5	66,70,73	3	5
75-84	74.5-84.5	76,77,75,80, 84,84	6	11
85-94	84.5-94.5	85,90,90,90	4	15
95-104	94.5-104.5	95,100, 98	3	18
105-114	104.5-114.5		0	18
115-124	114.5-124.5	120	1	19
125-134	124.5-134.5		0	19
135-144	134.5-144.5		0	19
145-154	144.5-154.5	150	1	20

ii). Cumulative frequency polygon



Q2: Make cumulative frequency table for

Age	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
No	1	2	16	10	22	20	15	14

Solution:

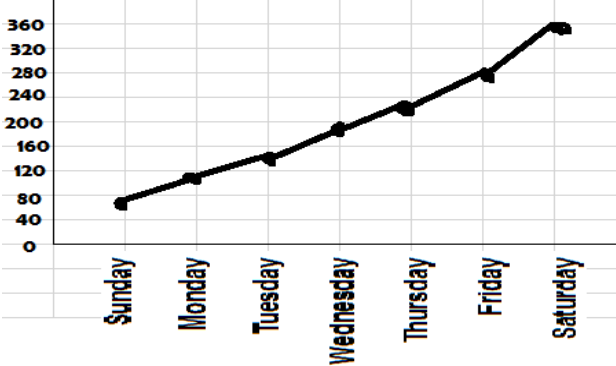
Age	Boundaries	No (f)	(cf)
20-24	19.5-24.5	1	1
25-29	24.5-29.5	2	3
30-34	29.5-34.5	16	19
35-39	34.5-39.5	10	29
40-44	39.5-44.5	22	51
45-49	44.5-49.5	20	71
50-54	49.5-54.5	15	86
55-59	54.5-59.5	14	100

Q3: In a city during the first week of August rainfall recorded is as follows. Construct a cumulative frequency graph

Sol: Since day are continuous

Day	Rainfall in ml	Cumulative frequency
Sunday	70	70
Monday	40	70 + 40 = 110
Tuesday	30	110 + 30 = 140
Wednesday	35	140 + 35 = 175
Thursday	50	175 + 50 = 225
Friday	55	225 + 55 = 280
Saturday	80	280 + 80 = 360

For Cumulative frequency graph

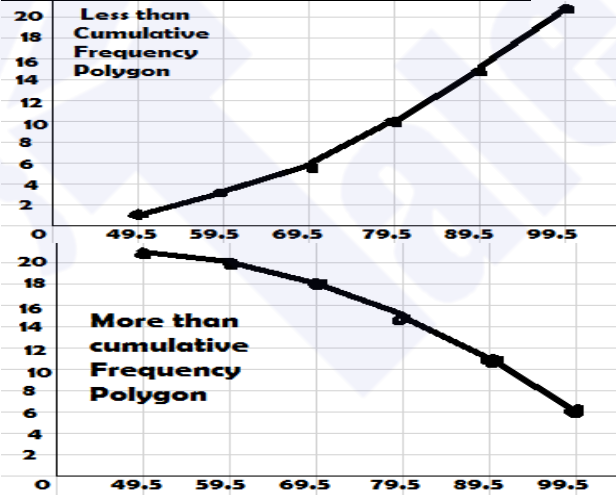


Q4. Draw less than and more than cumulative frequency polygon for

Marks	40-49	50-59	60-69	70-79	80-89	90-99
Students	1	2	3	4	5	6

Sol: Cumulative frequency distribution

Marks	Boundaries	f	c.f	
40-49	39.5-49.5	1	1	21
50-59	49.5-59.5	2	3	20
60-69	59.5-69.5	3	6	18
70-79	69.5-79.5	4	10	15
80-89	79.5-89.5	5	15	11
90-99	89.5-99.5	6	21	6



Q5. Determine from Q4

i). Number of students who obtained more than 50 marks

answer: 21-1=20

ii). Number of students who obtained less than 70 marks

Answer = 1+2+3=6

iii). Number of students who secured marks between 50 and 70.

Answer = 2+3=5

iv). Class interval of all classes.

Answer = $h = U - L$ so $h = 59.5 - 49.5 = 10$

v). Lower class boundary of 5th class

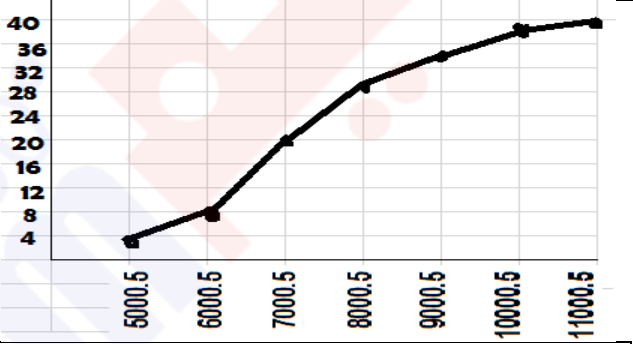
Answer = 79.5

Q3: Construct an Ogive for

Salary Groups	Workers
4000-5000	3
5001-6000	5
6001-7000	12
7001-8000	9
8001-9000	5
9001-10 000	4
10 001-11 000	2

Sol: Cumulative frequency distribution

Salary Groups	Class Boundaries	f	c.f
4000-5000	3999.5-5000.5	3	3
5001-6000	5000.5-6000.5	5	8
6001-7000	6000.5-7000.5	12	20
7001-8000	7000.5-8000.5	9	29
8001-9000	8000.5-9000.5	5	34
9001-10 000	9000.5-10 000.5	4	38
10 001-11 000	10 000.5-11 000.5	2	40



Arithmetic Mean for ungroup Data

Arithmetic Mean = $\frac{\text{Sum of quantities}}{\text{Number of quantities}}$

By Short-cut Method

$\bar{x} = a + \frac{\sum D_x}{n}$ where \bar{x} = arithmetic mean

a = assume mean, n = total number of values

$D_x = (x - a)$ (Deviation from provisional mean)

Exp10i). Find A.M of 2,3,4,5,6,7,8,9,10

Sol: $\bar{x} = \frac{2+3+4+5+6+7+8+9+10}{9}$

$\bar{x} = \frac{54}{9}$

Thus $\bar{x} = 6$

Exp10ii). Find A.M of 2,3,4,5,6,7,8,9,10 by shortcut method.

Sol: Let assume mean = 6

x	$D_x = (x - a), a = 6$
2	2-6 = - 4
3	3-6 = -3
4	4-6 = -2
5	5-6 = -1
6	6-6 = 0

7	7-6= 1
8	8-6= 2
9	9-6= 3
10	10-6= 4
	$\sum D_x = 0$

Using $\bar{x} = a + \frac{\sum D_x}{n}$ putting values

$$\bar{x} = 6 + \frac{0}{9}$$

Thus $\bar{x} = 6$

Arithmetic Mean for Group Data

$$\bar{x} = \frac{\sum f.x}{\sum f} = \frac{x_1.f_1 + x_2.f_2 + x_3.f_3 + \dots + x_n.f_n}{f_1 + f_2 + f_3 + \dots + f_n}$$

A. M for Group Data by Short cut Method

$$\bar{x} = a + \frac{\sum f.D_x}{\sum f} \text{ where } \bar{x} = \text{arithmetic mean}$$

a = assume mean, $\sum f$ total number of values

$D_x = (x - a)$ (Deviation from provisional mean)

Exp11: In a coaching class of 13 students, a test was conducted, and marks obtained are 10,12,12,14,9,18,9,13,16,9,17,16,14. Make frequency table and find arithmetic mean.

Sol: Frequency table

x	f	$f.x$
9	3	27
10	1	10
12	2	24
13	1	13
14	2	28
16	2	32
17	1	17
18	1	18
	$\sum f = 13$	$\sum f.x = 169$

Using formula

$$\bar{x} = \frac{\sum f.x}{\sum f} = \frac{169}{13}$$

Thus $\bar{x} = 13$

Exp12i): the price of 2kw generators are given along frequencies. Find mean

Price	90-94	95-99	100-104	105-109	110-114	115-119	120-124
f	4	11	15	24	18	9	3

Sol: price are in hundred rupees

Interval	X:midvalue	f	$f.x$
90-94	92	4	368
95-99	97	11	1067
100-104	102	15	1530

105-109	107	24	2568
110-114	112	19	2016
115-119	117	9	1053
120-124	122	3	366
		$\sum f = 85$	$\sum f.x = 8968$

Mean price of generators

$$\bar{x} = \frac{\sum f.x}{\sum f}$$

$$\bar{x} = \frac{8968}{85}$$

$\bar{x} = 105.5$ hundred rupees

$\bar{x} = 10550$ rupees

Exp12ii): the price of 2kw generators are given along frequencies. Find mean by shortcut method

Price	90-94	95-99	100-104	105-109	110-114	115-119	120-124
f	4	11	15	24	18	9	3

Sol: price are in hundred rupees Let $a = 107$

Interval	x	f	$D_x = x - a$	$f.x$
90-94	92	4	92-107=-15	-60
95-99	97	11	97-107=-10	-110
100-104	102	15	102-107=-5	-75
105-109	107	24	107-107=0	0
110-114	112	19	112-107=5	95
115-119	117	9	117-107=10	90
120-124	122	3	122-107=15	45
	\sum	85		-15

Using short cut method for assume mean

$$\bar{x} = a + \frac{\sum f.D_x}{\sum f} \text{ putting the values}$$

$$\bar{x} = 107 + \left(\frac{-15}{85} \right)$$

$$\bar{x} = 107 - 0.17$$

$\bar{x} = 106.83$ hundred rupees

$\bar{x} = 10683$ rupees

Median for ungroup Data

Data should be in increasing order and

$$\text{Median} = \frac{n+1}{2} \text{th item (when } n \text{ is odd)}$$

$$\text{Median} = \frac{1}{2} \left(\frac{n}{2} \text{th item} + \frac{n+2}{2} \text{th item} \right) \text{ (when } n \text{ is even)}$$

Exp13: Find the median for 2,4,5,6,3

Sol: In increasing order 2,3,4,5,6 and number of quantities = 5 which is odd

$$\text{Median} = \frac{5+1}{2} \text{th item}$$

Median = 3rd item

So, Median = 4

Exp14: Daily pocket money in rupees for children of a family 10,20,15,30. Calculate median

Sol: In increasing order 10,15,20,30.

And number of quantities = 4 which is even

$$\text{Median} = \frac{1}{2} \left(\frac{4}{2}th + \frac{4+2}{2}th \right) \text{ items}$$

$$\text{Median} = \frac{1}{2} (2^{nd} + 3^{rd}) \text{ items}$$

$$\text{Median} = \frac{1}{2} (10 + 15) = \frac{35}{2}$$

Median = 17.5 rupees

Median for Group data (Discrete Data)

In a frequency distribution if $\sum f$ is odd

$$\text{Median} = \left(\frac{\sum f + 1}{2} \right) \text{th item}$$

In a frequency distribution if $\sum f$ is even

$$\text{Median} = \frac{1}{2} \left(\frac{\sum f}{2} + \frac{\sum f + 2}{2} \right) \text{th items}$$

Exp15: Marks obtained by 35 students in test

x	10	12	15	20	25	30
f	1	10	5	13	2	4

Sol: Cumulative distribution for discrete data

x	f	$c.f$
10	1	1
12	10	11
15	5	16
20	13	29
25	2	31
30	4	35

Here $\sum f = 35$ which is odd, So

$$\text{Median} = \frac{35+1}{2} \text{th item}$$

Median = 18 th item

Median = 20

Exp16: Find median marks from

Marks x	10	20	22	25
No of students	0	2	4	6

Sol: cumulative distribution

x	f	$c.f$
10	0	0
20	2	2
22	4	6
25	6	12

Here $\sum f = 12$ which is even

$$\text{Median} = \frac{1}{2} \left(\frac{12}{2}th + \frac{12+2}{2}th \right) \text{ items}$$

$$\text{Median} = \frac{1}{2} (6th + 7th) \text{ items}$$

$$\text{Median} = \frac{1}{2} (22 + 25) = \frac{1}{2} (45)$$

$$\text{Median} = 22.5$$

Medians for Group data (continuous data)

$$\text{Median} = L + \frac{h}{f} \left(\frac{n}{2} - c \right) \text{ For Group data where}$$

l = Lower class boundary of median class

h = Magnitude (Length) of Class interval,

f = frequency of median class

c = cumulative frequency of preceding median class

Exp17: Find median of the distribution

Wages	60-69	70-79	80-89	90-99	100-109
Labour	4	6	8	10	5

Sol: cumulative frequency distribution

Wages	Boundaries	f	$c.f$
60-69	59.5-69.5	4	4
70-79	69.5-79.5	6	10
80-89	79.5-89.5	8	18
90-99	89.5-99.5	10	28
100-109	99.5-109.5	5	33

$$\text{Median class } \frac{\sum f}{2} = \frac{n}{2} = \frac{33}{2} = 16.5$$

contains in the interval [80,89]

$$\text{Median} = l + \frac{h}{f} \left(\frac{n}{2} - c \right)$$

$$\begin{aligned} \text{Median} &= 79.5 + \frac{10}{8} (16.5 - 10) \\ &= 79.5 + 8.125 \\ &= 87.625 \end{aligned}$$

Mode of ungroup data

The value that appears more times in data, is called mode or most frequent value

Exp18: Find model size from sizes of trousers, 25,30,31,25,35,25

Sol: the most frequent value, Mode = 25

Exp19: Find the model weight when Weights of students are

Weight	40	42	50	51	55
Students	10	8	3	2	1

Sol: Given data is in Grouped but Discrete

Therefore Median = most repeating

Median = 40 because 40 is most frequent

Mode of Group Data (continuous Data)

$$\text{Mode} = l + \frac{f_m - f_0}{(f_m - f_0) + (f_m - f_1)} \times h \text{ or}$$

$$\text{Mode} = l + \frac{f_m - f_0}{2f_m - f_0 - f_1} \times h$$

f_m = Frequency of the model Class

l = Lower class boundary of modal class

h = Magnitude of Class interval,

f_o = Frequency of preceding modal class,

f_1 = Frequency of the following modal class.

Exp20: Calculate Mode from

Marks	0-4	4-8	8-12	12-16	16-20
Student	3	5	4	6	2

Sol: Given interval have no gap so

Marks	No of students
0-4	3
4-8	5
8-12	4
12-16	6
16-20	2

$$\begin{aligned}\text{Mode} &= 12 + \left(\frac{6-4}{2(6)-4-2} \right) \times 4 \\ &= 12 + \frac{2 \times 4}{6} \\ &= 13.33\end{aligned}$$

Geometric Mean of ungroup data

$$GM = \sqrt[n]{x_1 \times x_2 \times x_3 \times \dots \times x_n} \text{ or}$$

$GM = (x_1 \times x_2 \times x_3 \times \dots \times x_n)^{\frac{1}{n}}$ some time we can not calculate with the help of calculator so, Taking log on both sides

$$\log GM = \frac{1}{n} \log (x_1 \times x_2 \times x_3 \times \dots \times x_n)$$

$$\log GM = \frac{1}{n} \{ \log x_1 + \log x_2 + \log x_3 + \dots + \log x_n \}$$

$$\log GM = \frac{1}{n} \sum \log x_i$$

Taking anti-log on both sides

$$GM = \text{anti} - \log \left\{ \frac{1}{n} \sum \log x_i \right\}$$

Exp21. Find Geometric Mean of the marks 60,65,70,80,85,90,75

Sol: taking log of each number

x	$\log x$
60	Log 60= 1.7781
65	Log65=1.8129
70	Log70=1.8450
75	Log75=1.8750
80	Log80=1.9030
85	Log85=1.9294
90	Log90=1.9542
	$\sum \log x_i = 13.0976$

Using $GM = \text{anti} - \log \left\{ \frac{1}{n} \sum \log x_i \right\}$ putting

$$GM = \text{anti} - \log \left\{ \frac{1}{7} (13.0976) \right\}$$

$$GM = \text{anti} - \log 1.8710$$

$$GM = 74.31$$

Geometric Mean of Group data

$$GM = \text{anti} - \log \left\{ \frac{1}{\sum f} \times \sum f \cdot \log x_i \right\}$$

Exp22: Find the Geometric mean for

Marks	0-20	20-40	40-60	60-80
Students	3	4	10	11

Sol:

Marks	x	f	$\log x_i$	$f \cdot \log x_i$
0-20	10	3	1	3
20-40	30	4	1.4771	5.9084
40-60	50	10	1.6989	16.989
60-80	70	11	1.8450	20.295
	$\sum f =$	28	$\sum f \cdot \log x_i$	46.1924

Using $GM = \text{anti} - \log \left\{ \frac{1}{\sum f} \times \sum f \cdot \log x_i \right\}$ put

$$GM = \text{anti} - \log \left\{ \frac{1}{28} \times (46.1924) \right\}$$

$$GM = \text{anti} - \log (1.6497)$$

$$GM = 44.64$$

Harmonic Mean of ungroup data

$$H.M = \frac{n}{\frac{1}{x_1} + \frac{1}{x_2} + \frac{1}{x_3} + \dots + \frac{1}{x_n}}$$

$$HM = \frac{n}{\sum \left(\frac{1}{x_i} \right)}$$

Exp23: Find Harmonic mean of 5,6,8,9 and 10

Sol: Given number are 5,6,8,9,10 now using

$$HM = \frac{n}{\sum \left(\frac{1}{x_i} \right)} \text{ putting values}$$

$$HM = \frac{5}{\frac{1}{5} + \frac{1}{6} + \frac{1}{8} + \frac{1}{9} + \frac{1}{10}}$$

$$HM = \frac{5}{0.2 + 0.16 + 0.125 + 0.11 + 0.1}$$

$$HM = \frac{5}{0.695} = 7.194$$

Harmonic Mean of Group data

$$H.M = \frac{\sum f}{\frac{f_1}{x_1} + \frac{f_2}{x_2} + \frac{f_3}{x_3} + \dots + \frac{f_n}{x_n}}$$

Or
$$HM = \frac{\sum f}{\sum \left(\frac{f_i}{x_i}\right)}$$

Exp24: Find Harmonic mean for

Classes	0-6	6-12	12-18	18-24	24-30
<i>f</i>	1	2	5	4	6

Sol:

Classes	Midpoint	<i>f</i>	<i>f</i> / <i>x</i>
0-6	3	1	1/3=0.33
6-12	9	2	2/9=0.22
12-18	15	5	5/15=0.33
18-24	21	4	4/21=0.19
24-30	27	6	6/27=0.22
		18	1.29

Using formula $HM = \frac{\sum f}{\sum \left(\frac{f_i}{x_i}\right)}$ putting

Thus $HM = \frac{18}{1.29} = 13.95$

Weight mean for ungroup data

$$\bar{x}_w = \frac{x_1w_1 + x_2w_2 + x_3w_3 + \dots + x_nw_n}{w_1 + w_2 + w_3 + \dots + w_n}$$

$$\bar{x}_w = \frac{\sum x_iw_i}{\sum w_i}$$

Exp25: Marks obtained by students in maths English, Urdu and Statistics were 70,60,80,65 respectively. Find the average weight of 2,1,3,1 are assigned to marks.

Sol:

<i>x_i</i>	<i>w_i</i>	<i>x_i w_i</i>
70	2	140
60	1	60
80	3	240
65	1	65
Sum	7	505

Now using $\bar{x}_w = \frac{\sum x_iw_i}{\sum w_i}$ Putting values

$$\bar{x}_w = \frac{505}{7} = 72.14$$

Moving Mean of ungroup data

It is succession of averages derived from the successive segments of series of values. It is continuously recomputed as new data becomes available. It progresses by dropping the earliest value and adding the latest value.

Exp26: During the first week of May, daily temperatures were recorded as given in table. Calculate 3-day moving average temperature.

Days	Sat	Sun	Mon	Tue	Wed	Thu	Fri
Temperature	40	37	36	38	37	41	39

Sol:

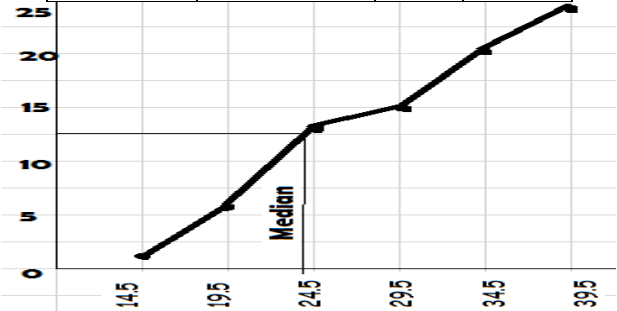
Days	Temperature	3-day moving Average
Sat	40
Sun	37	$\frac{40 + 37 + 36}{3} = 37.67$
Mon	36	$\frac{37 + 36 + 38}{3} = 37$
Tue	38	$\frac{36 + 38 + 37}{3} = 37$
Wed	37	$\frac{38 + 37 + 41}{3} = 38.67$
Thu	41	$\frac{37 + 41 + 39}{3} = 39$
Fri	39

Exp27. Find median graphically for

Classes	10-14	15-19	20-24	25-29	30-34	35-39
<i>f</i>	1	5	7	2	6	4

Sol: Cumulative frequency distribution

Classes	Boundaries	<i>f</i>	<i>c.f</i>
10-14	9.5-14.5	1	1
15-19	14.5-19.5	5	6
20-24	19.5-24.5	7	13
25-29	24.5-29.5	2	15
30-34	29.5-34.5	6	21
35-39	34.5-39.5	4	25



Median = $\frac{n}{2}$ th item = $\frac{25}{2}$ th item = 12.5th item

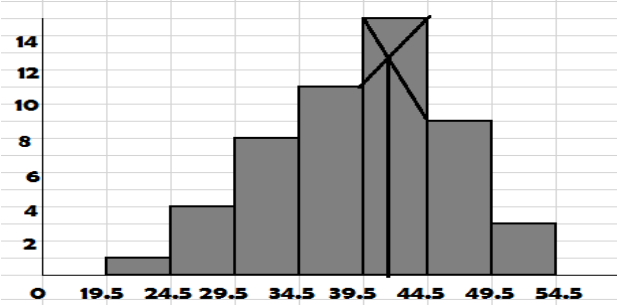
Median = 24.14

Exp28: Find mode graphically from

<i>x</i>	20-24	25-29	30-34	35-39	40-44	45-49	50-54
<i>f</i>	1	4	8	11	15	9	2

Sol:

Classes	Boundaries	f
20-24	19.5-24.5	1
25-29	24.5-29.5	4
30-34	29.5-34.5	8
35-39	34.5-39.5	11
40-44	39.5-44.5	15 f_m
45-49	44.5-49.5	9
50-54	49.5-54.5	2



Here Height class is 39.5 to 44.5 by joining we get the point of intersection. Then draw an altitude from point of intersection to horizontal axis to get median = 41.5 (approx)

Quartiles

1st Quartile $Q_1 = \frac{n}{4}$

2nd Quartile $Q_2 = \frac{n}{2} = \text{Median}$

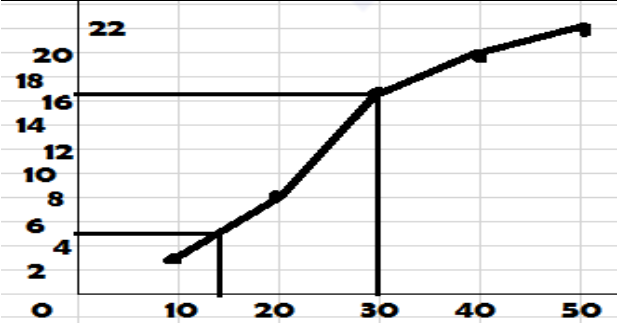
3rd Quartile $Q_3 = \frac{3n}{4}$

Exp29. Find Q_1 & Q_3 from

Marks	0-10	10-20	20-30	30-40	40-50
f	3	5	9	3	2

Sol: there is no gap in intervals so

Marks	f	c.f
0-10	3	3
10-20	5	8
20-30	9	17
30-40	3	20
40-50	2	22



Location of $Q_1 = \frac{n}{4} = \frac{22}{4} = 5.5^{th} = 15 \text{ marks}$

Location of $Q_3 = \frac{3n}{4} = \frac{3(22)}{4} = 16.5^{th} = 30 \text{ Marks}$

Exercise 6.3

Q1: Weights of students of 10th grade
45,30,25,36,42,27,31,43,49,50

Calculate mean of the weights

Sol: Since Arithmetic Mean = $\frac{\text{Sum of quantities}}{\text{Number of quantities}}$

$AM = \frac{45+30+25+36+42+27+31+43+49+50}{10}$

$AM = \frac{378}{10}$

$AM = 37.8$

Q2. Weights of students of 10th grade
45,30,25,36,42,27,31,43,49,50

Calculate mean by short cut Method

Sol: Let assume mean = 36

x	$D_x = x - a$
45	45-36=9
30	30-36=-6
25	25-36=-11
36	36-36=0
42	42-36=6
27	27-36=-9
31	31-36=-5
43	43-36=7
49	49-36=13
50	50-36=14
	Sum=18

Using $\bar{x} = a + \frac{\sum D_x}{n}$ putting values

$\bar{x} = 36 + \frac{18}{10} = 37.8$

Q3. Using an assumed mean, find the mean of following numbers 1242, 1248, 1252, 1244, 1249

Solution: Let Assumed mean a = 1244

X	$D = x - a$	$D = x - a$
1242	1242-1244	-2
1244	1244-1244	0
1248	1248-1244	4
1249	1249-1244	5
1252	1252-1244	8
	$\sum D$	15

$\bar{x} = a + \frac{\sum D}{n}$

$\bar{x} = 1244 + \frac{15}{5}$

$\bar{x} = 1244 + 3$

$\bar{x} = 1247$

Q4: Find mean marks obtained by students of 9th class in maths.

Score	0-15	16-31	32-47	48-63	64-75
f	0	10	40	70	45

Solution:

Score	$x = \frac{L+U}{2}$	(f)	fx
0-15	7.5	0	0
16-31	23.5	10	235
32-47	39.5	40	1580
48-63	55.5	70	3885
64-75	69.5	45	3127.5
		$\sum f = 165$	$\sum fx = 8827.5$

Using formula of arithmetic mean for group data

$$\bar{x} = \frac{\sum fx}{\sum f}$$
$$\bar{x} = \frac{8827.5}{165}$$
$$\bar{x} = 53.5$$

Q5i): Find the median of Heights of boys in inches 64, 65, 65, 66, 66, 67

Sol: Given data is arrange

Number of the terms = 6 which is even

$$\text{Median} = \frac{1}{2} \left(\frac{6}{2} \text{th} + \frac{6+2}{2} \text{th} \right) \text{terms}$$

$$\text{Median} = \frac{1}{2} (3\text{rd} + 4\text{th}) \text{terms}$$

$$\text{Median} = \frac{1}{2} (65 + 66)$$

$$\text{Median} = \frac{1}{2} (131) = 65.5$$

Q5ii). Find the median of Salaries of 8 workers of a factory 7000, 6600, 8000, 4500, 7500, 11000, 9000, 7500

Sol: First we arrange the given data

4500, 6600, 7000, 7500, 7500, 8000, 9000, 11000

Number of the terms = 8 which is even

$$\text{Median} = \frac{1}{2} \left(\frac{8}{2} \text{th} + \frac{8+2}{2} \text{th} \right) \text{terms}$$

$$\text{Median} = \frac{1}{2} (4\text{th} + 5\text{th}) \text{terms}$$

$$\text{Median} = \frac{1}{2} (7500 + 7500)$$

$$\text{Median} = \frac{1}{2} (15000) = 7500$$

Q6 Find the Arithmetic mean, Geometric mean, median and mode of the following data 58, 59, 60, 62, 64, 64, 65, 67, 67, 68, 70, 71, 71, 71, 73

Sol:

S.NO	X	Log x
1	58	1.7634
2	59	1.7709
3	60	1.7782
4	62	1.7924
5	64	1.8062
6	64	1.8062
7	65	1.8129
8	67	1.8261
9	67	1.8261
10	68	1.8325
11	70	1.8451
12	71	1.8513
13	71	1.8513
14	71	1.8513
15	73	1.8633
\sum	990	27.2770

$$\text{Arithmetic Mean} = \frac{\text{Sum of quantities}}{\text{Number of quantities}}$$

$$\text{Arithmetic Mean} = \frac{990}{15}$$

$$\text{Arithmetic Mean} = 66$$

$$\text{Geometric Mean} = \text{Antilog} \left(\frac{1}{n} \sum \log x \right)$$

$$\text{Geometric Mean} = \text{Antilog} \left(\frac{1}{15} (27.2770) \right)$$

$$\text{Geometric Mean} = \text{Antilog}(1.8185)$$

$$\text{Geometric Mean} = 65.83$$

Now Median when n = 15 which is odd

$$\text{Median} = \frac{n+1}{2} \text{th term}$$

$$\text{Median} = \frac{16}{2} \text{th term}$$

$$\text{Median} = 8\text{th term}$$

$$\text{Median} = 67$$

$$\text{Mode} = \text{Most repeating term}$$

$$\text{Mode} = 71$$

Q7: A set of data contains the values of 148, 145, 160, 157, 156, & 160 show that Mode > Median > Mean

$$\text{Sol: A.Mean} = \frac{\text{Sum of quantities}}{\text{Number of quantities}}$$

$$\text{Mean} = \frac{148+145+160+157+156+160}{6}$$

$$\text{Mean} = \frac{926}{6} = 154.3$$

Now For Median Arrange the given numbers 145, 148, 156, 157, 160, 160,

Number of the terms = 6 which is even

$$\text{Median} = \frac{1}{2} \left(\frac{6}{2} \text{th} + \frac{6+2}{2} \text{th} \right) \text{terms}$$

$$\text{Median} = \frac{1}{2} (3\text{rd} + 4\text{th}) \text{terms}$$

$$\text{Median} = \frac{1}{2} (156 + 157)$$

$$\text{Median} = 156.5$$

$$\text{Mode} = \text{Most repeating term}$$

$$\text{Mode} = 160$$

$$\text{Thus Mode} > \text{Median} > \text{Mean}$$

$$\text{i.e., } 160 > 156.5 > 154.3$$

Q8. From this distribution

Wages	112-116	117-121	122-126	127-131	132-136
Workers	3	20	11	4	5

i). Construct a frequency table

ii). Find class boundaries for each group

iii). Calculate Median, Mode, Harmonic mean and Geometric mean for the table.

Sol. Cumulative frequency table

Wages	Boundaries	x	f	c.f
112-116	111.5-116.5	114	3 f_0	3
117-121	116.5-121.5	119	20 f_m	23
122-126	121.5-126.5	124	11 f_1	34
127-131	126.5-131.5	129	4	38
132-136	131.5-136.5	134	5	43

For Median $\frac{\sum f}{2} = \frac{43}{2} = 21.5$ so median

class is [117,121] using formula

$$\begin{aligned}\text{Median} &= l + \frac{h}{f} \left(\frac{n}{2} - c \right) \\ &= 116.5 + \frac{5}{20} (21.5 - 3) \\ &= 116.5 + \frac{1}{4} (18.5)\end{aligned}$$

Median = 121.125

$$\text{Now Mode} = l + \frac{f_m - f_0}{2f_m - f_0 - f_1} \times h$$

f_m contains [117,121]. so,

$$\begin{aligned}\text{Mode} &= 116.5 + \frac{20 - 3}{2(20) - 3 - 11} \times 5 \\ &= 116.5 + \frac{17 \times 5}{27}\end{aligned}$$

Mode = 119.648

Wages	x	f	f/x
112-116	114	3	$3/114=0.026$
117-121	119	20	$20/119=0.168$
122-126	124	11	$11/124=0.089$
127-131	129	4	$4/129=0.031$
132-136	134	5	$5/134=0.037$
Sum		43	0.351

Using formula $HM = \frac{\sum f}{\sum \left(\frac{f_i}{x_i} \right)}$ putting

$$HM = \frac{43}{0.351} = 122.5$$

Wages	x	f	$\log x$	$f \cdot \log x$
112-116	114	3	$\log 114=2.0569$	6.1707
117-121	119	20	$\log 119=2.0775$	41.5500
122-126	124	11	$\log 124=2.0934$	23.0274
127-131	129	4	$\log 129=2.1106$	8.4424
132-136	134	5	$\log 134=2.1271$	10.6355
Sum		43		89.8260

$$GM = \text{anti} - \log \left\{ \frac{1}{\sum f} \times \sum f \cdot \log x_i \right\}$$

$$GM = \text{anti} - \log \left\{ \frac{1}{43} \times (89.8260) \right\}$$

$$GM = \text{anti} - \log (2.0890)$$

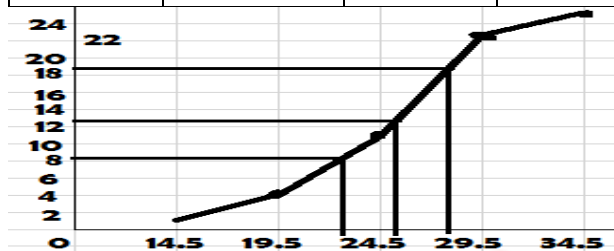
GM=122.7374

Q9. Find median Q1, Q3 and mode Graphically

Classes	10-14	15-19	20-24	25-29	30-34
f	1	3	7	12	2

Sol: Cumulative frequency distribution

Classes	Boundaries	f	$c.f$
10-14	9.5-14.5	1	1
15-19	14.5-19.5	3	4
20-24	19.5-24.5	7	11
25-29	24.5-29.5	12	23
30-34	29.5-34.5	2	25



$$1^{\text{st}} \text{ Quartile } Q_1 = \frac{n}{4} = \frac{25}{4} = 8.25$$

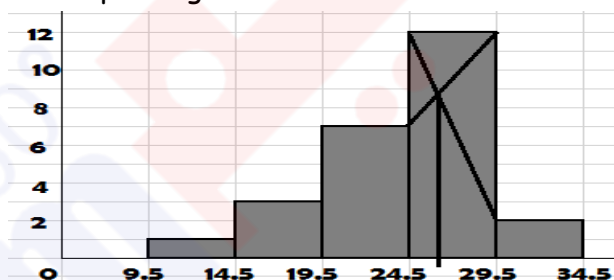
Corresponding value = 21

$$2^{\text{nd}} \text{ Quartile } Q_2 = \frac{n}{2} = \frac{25}{2} = 12.5 \text{ Median}$$

Corresponding value = 25

$$3^{\text{rd}} \text{ Quartile } Q_3 = \frac{3n}{4} = \frac{3(25)}{4} = 18.75$$

Corresponding value = 28



From the Histogram Mode = 26 (approx)

Measure Dispersion

Dispersion is the scatterdness of values from its central value

- Range
- Standard Deviation
- Variance

Range: Range is the numerical difference of Largest and smallest values in a given data.

Exp30: What is the range of 209,260,270,311,311.

Sol: Maximum = 311, Minimum = 209

Range = Maximum - minimum

Range = 311-209

Range = 102

Exp31: Find the range of height from

K -2	8611m
Ghasherbrum-I	8068m
Broad	8047m
Ghasherbrum-II	8035m
Ghasherbrum-III	7952m
Ghasherbrum-IV	7925m
Rakaposhi	7788m

Sol: Maximum = 8611m , Minimum = 7788m

Range = Maximum - minimum

Range = 8611m - 7788m

Range = 823m

Exp32: Calculate the range

Classes	5-9	10-14	15-19	20-24	25-29
f	10	15	12	21	3

Sol:

Classes	Boundaries	Frequency
5-9	4.5-9.5	10
10-14	9.5-14.5	15
15-19	14.5-19.5	12
20-24	19.5-24.5	21
25-29	24.5-29.5	3

Lower limit of first group = 4.5

Upper limit of last group = 29.5

Range = 29.5 - 4.5

Range = 25

Exp33: For 9,8,9,8,9,13,24 find mean, median, mode, and range then select appropriate measure of central tendency or range to describe the data, justify your answer.

Sol: Given numbers 8,8,9,9,9,13,24 in order

Mean = $\frac{8+8+9+9+9+13+24}{7} = 11.6$

Median = $\frac{7+1}{2}$ th item = 9

Mode = 9 occurs most frequently

Range = 24 - 8 = 16

The appropriate measure of central tendency or range to describe the data is median or mode.

The mean is affected by the highest value 24

Standard Deviation: Standard deviation is the positive square root of average of squared deviations measured from AM.

Standard Deviation for Ungroup data

$S.D = \sqrt{\frac{\sum dx^2}{n}}$ where $dx^2 = (x - \bar{x})^2$ ungroup

$S.D = \sqrt{\frac{\sum f dx^2}{\sum f}}$ where $dx^2 = (x - \bar{x})^2$ Group

Variance: Variance is a single value obtained by dividing the sum of the squares of the deviations taken from the arithmetic mean by the total number of observation ins the data set.

$S^2 = \frac{\sum (x - \bar{x})^2}{n}$ or $S^2 = \frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2$ Ungroup

$S^2 = \frac{\sum f (x - \bar{x})^2}{n}$ or $S^2 = \frac{\sum f x^2}{\sum f} - \left(\frac{\sum f x}{\sum f}\right)^2$ Group

For discrete and continuous data

Exp34: Find variance and standard deviation
6,8,10,12,14

Sol: Given number are 6,8,10,12,14

$\bar{x} = \frac{6+8+10+12+14}{5} = \frac{50}{5} = 10$

x	$x - \bar{x}$	$(x - \bar{x})^2$
6	6-10=-4	16
8	8-10=-2	4
10	10-10=0	0

12	12-10=2	2
14	14-10=4	16
	Sum	40

$S.D = \sqrt{\frac{\sum (x - \bar{x})^2}{n}} = \sqrt{\frac{40}{5}} = \sqrt{8}$

Variance $S^2 = (\sqrt{8})^2 = 8$

Exp35: Find standard deviation and variance

Rotten eggs	0-4	4-8	8-12	12-16	16-20	20-24
Crates	5	10	15	20	6	4

Sol:

C.B	f	x	f.x	x ²	f.x ²
0-4	5	2	10	4	20
4-8	10	6	60	36	36
8-12	15	10	150	100	1500
12-16	20	14	280	196	3920
16-20	6	18	108	324	1944
20-24	4	22	88	484	1936
	60		696		9680

Variance $S^2 = \frac{\sum f.x^2}{\sum f} - \left(\frac{\sum f.x}{\sum f}\right)^2$

$S^2 = \frac{9680}{60} - \left(\frac{696}{60}\right)^2$

$S^2 = 161.33 - 134.56$

$S^2 = 26.77$

Standard Deviation = $\sqrt{S^2} = \sqrt{26.77} = 5.18$

Exercise 6.4

Q1. Find the range of 11,13,15,21,19,23

Sol: Given numbers are 11,13,15,21,19,23

Maximum number = 23, minimum number =11

Range = Maximum - minimum

Range = 23 -11

Range = 12

Q2: A bank branch manager, interested in waiting times of customers carried out a survey A random sample of 12 customers is selected and yielded following 5.90, 9.66, 5.79, 8.02, 8.73, 8.01, 10.49, 8.35, 6.68, 5.64, 5.47, 9.91, Sol:

S.NO	X	$x - \bar{x}$	$x - \bar{x}$	$(x - \bar{x})^2$
1	5.47	5.47-7.72	-2.25	5.0625
2	5.64	5.64-7.72	-2.08	4.3264
3	5.79	5.79-7.72	-1.93	3.7249
4	5.90	5.90-7.72	-1.82	3.3124
5	6.68	6.68-7.72	-1.04	1.0816
6	8.01	8.01-7.72	0.29	0.0841
7	8.02	8.02-7.72	0.30	0.0900
8	8.35	8.35-7.72	0.63	0.3969
9	8.73	8.73-7.72	1.01	1.0201

10	9.66	9.66-7.72	1.94	3.7636
11	9.91	9.91-7.72	2.19	4.7961
12	10.49	10.49-7.72	2.77	7.6729
$\sum x$	92.65	$\sum (x - \bar{x})^2$		35.3315

i). Find the value of Average

$$\text{Average} = \frac{\text{Sum of quantities}}{\text{Number of quantities}}$$

$$\text{Average} = \frac{92.65}{12}$$

$$\text{Average} = 7.72$$

ii). Find the value of Median

Number of the terms = 12 which is even

$$\text{Median} = \frac{1}{2} \left(\frac{12}{2} \text{th} + \frac{12+2}{2} \text{th} \right) \text{ terms}$$

$$\text{Median} = \frac{1}{2} (6\text{th} + 7\text{th}) \text{ terms}$$

$$\text{Median} = \frac{1}{2} (8.01 + 8.02)$$

$$\text{Median} = \frac{1}{2} (16.03) = 8.015$$

iii). Find the value of Standard deviation

$$\text{Standard deviation} = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

$$\text{Standard deviation} = \sqrt{\frac{35.3315}{12}}$$

$$\text{Standard deviation} = \sqrt{2.944291667}$$

$$\text{Standard deviation} = 1.715893839$$

Q3. Calculate the Range, Variance and standard deviation for discrete data

x	5	10	11	13	15
f	2	3	4	1	5

Sol:

x	f	$c.f$	$f.x$	x^2	$f.x^2$
5	2	2	10	25	50
10	3	5	30	100	300
11	4	9	44	121	484
13	1	10	13	169	169
15	5	15	75	225	1125
Sum	15		172		2128

i). Find the Range

Sol: Maximum value = 15, minimum value = 5

Range = Maximum - minimum

Range = 15 - 5

Range = 10

ii). Find the Variance

$$\text{Sol: } \bar{x} = \frac{\sum f.x}{\sum f} = \frac{172}{15}$$

$$\bar{x} = 11.47$$

$$\text{Using variance} = \frac{\sum f.x^2}{\sum f} - \left(\frac{\sum f.x}{\sum f} \right)^2$$

$$\text{Variance } S^2 = \frac{2128}{15} - \left(\frac{172}{15} \right)^2$$

$$\text{Variance } S^2 = 141.87 - 131.48$$

$$\text{Variance } S^2 = 10.49$$

iii). Standard deviation

$$\text{Sol: Standard deviation} = \sqrt{\frac{\sum f.x^2}{\sum f} - \left(\frac{\sum f.x}{\sum f} \right)^2}$$

$$S.D = \sqrt{\frac{2128}{15} - \left(\frac{172}{15} \right)^2}$$

$$S.D = \sqrt{141.87 - 131.48}$$

$$S.D = 3.22$$

Q4: Following table shows the marks obtained by 10 student of two sections of 10th class

Sec A	7	9	6	9	4	7	5	8	8	7
Sec B	6	10	6	4	2	8	10	6	9	9

Solutoin:

Sec A	$x - \bar{x}$	$(x - \bar{x})^2$	Sec B	$x - \bar{x}$	$(x - \bar{x})^2$
7	0	0	6	-1	1
9	2	4	10	3	9
6	-1	1	6	-1	1
9	2	4	4	-3	9
4	-3	9	2	-5	25
7	0	0	8	1	1
5	-2	4	10	3	9
8	1	1	6	-1	1
8	1	1	9	2	4
7	0	0	9	2	4
70		24			64

Find their

a). Arithmetic mean

Section A

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

$$\bar{x} = \frac{70}{10}$$

$$\bar{x} = 7$$

b). Variance

Section A

$$\text{Variance} = \frac{\sum (x - \bar{x})^2}{n}$$

$$\text{Variance} = \frac{24}{10}$$

$$\text{Variance} = 2.4$$

Section B

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

$$\bar{x} = \frac{70}{10}$$

$$\bar{x} = 7$$

Section B

$$\text{Variance} = \frac{\sum (x - \bar{x})^2}{n}$$

$$\text{Variance} = \frac{64}{10}$$

$$\text{Variance} = 6.4$$

Q5: Following are the marks (out of 75) of eight students in two subjects.

Student	A	B	C	D	E	F	G	H
Maths	54	63	59	45	52	35	61	68
Physics	52	55	57	51	56	58	50	59

Sol:

Stude nt	Marks Maths	$x - \bar{x}$	$(x - \bar{x})^2$	Marks Physic	$x - \bar{x}$	$(x - \bar{x})^2$
A	54	-0.625	0.39	52	-2.75	7.5625
B	63	8.375	70.14	55	0.25	0.0625

C	59	4.375	19.14	57	2.25	5.0625
D	45	-9.625	92.64	51	-3.75	14.0625
E	52	-2.625	6.89	56	1.25	1.5625
F	35	-19.625	385.14	58	3.25	10.5625
G	61	6.375	40.64	50	-4.75	22.5625
H	68	13.375	178.89	59	4.25	18.0625
	437		721.50	438		79.50

Math

$$\bar{x} = \frac{\sum x}{n}$$

$$\bar{x} = \frac{437}{8}$$

$$\bar{x} = 54.625$$

Maths

$$S.D = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

$$S.D = \sqrt{\frac{793.875}{8}}$$

$$S.D = \sqrt{99.23}$$

$$S.D = 9.96$$

Physic

$$\bar{x} = \frac{\sum x}{n}$$

$$\bar{x} = \frac{438}{8}$$

$$\bar{x} = 54.75$$

Physic

$$S.D = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

$$S.D = \sqrt{\frac{79.50}{8}}$$

$$S.D = \sqrt{9.9375}$$

$$S.D = 3.15238$$

Physic is more consistent because SD is less

Q6. Number of defective bulbs in 30 cartons. Find variance and standard deviation of defective bulbs.

Defective	0-2	2-4	4-6	6-8	8-10
Packs	1	3	15	10	2

Sol:

C.B	x	f	$f \cdot x$	x^2	$f \cdot x^2$
0-2	1	1	1	1	1
2-4	3	3	9	9	27
4-6	5	15	75	25	375
6-8	7	10	70	49	490
8-10	9	2	18	81	162
Sum		31	173		1055

$$\text{Sol: } \bar{x} = \frac{\sum f \cdot x}{\sum f} = \frac{173}{31}$$

$$\bar{x} = 5.58$$

$$\text{Variance} = \frac{\sum f \cdot x^2}{\sum f} - \left(\frac{\sum f \cdot x}{\sum f} \right)^2$$

$$S^2 = \frac{1055}{31} - \left(\frac{173}{31} \right)^2$$

$$S^2 = 34.03 - 5.58^2$$

$$S^2 = 34.03 - 31.14$$

$$\text{Variance} = 2.89$$

Now Standard deviation

$$S.D = \sqrt{S^2}$$

$$S.D = \sqrt{2.89}$$

$$S.D = 1.7$$

Review Exercise 6

Q1: Fill the correct circle

i). The difference between upper limit of two consecutive classes in frequency table is

☐ Class limit ☐ Class interval

☐ Class Mark ☐ Range

ii). A cumulative frequency curve is also called

☐ Histogram ☐ Pie Chart

☐ Ogive ☐ Frequency polygon

iii). The number of time a value appears on a set of data is called

☐ Frequency ☐ Average

☐ Mode ☐ Median

iv). Mode of data 3,2,1,1,1,5,3,1,2,1,2 is

☐ 1

☐ 2

☐ 3

☐ 4

v). In which data set are the mean, median, mode and range all are same

☐ 1,2,3,3,1,2 ☐ 1,2,3,1,2,3,1

☐ 1,3,3,3,2,3,1 ☐ 2,2,1,2,3,2,3

vi). The nth root of product of n number of values is called

☐ Arithmetic mean ☐ Geometric mean

☐ Harmonic mean ☐ Standard Deviation

vii). In a set of data 63, 65, 66, 67, 69 median is

☐ 63 ☐ 66

☐ 67 ☐ 69

viii). In a set of data 41,43,47,51,57,52,59 median is

☐ 51 ☐ 66

☐ 67 ☐ 69

ix). In a set of data 5, 7, 7, 5, 3, 7, 2, 8, 2 mode is

☐ 9 ☐ 5

☐ 2 ☐ 7

x). In a set of data 5, 5, 5, 5, 5, 5, 5 the standard deviation is

☐ 5 ☐ 0

☐ 7 ☐ none of these

xi). The average pocket money of 30 students is Rs. 20/- the total amount in the class

☐ Rs. 20/- ☐ Rs. 30/-

☐ Rs. 300/- ☐ Rs. 600/-

xii). The sum of 30 observation is 1500 its average will be

- O 1500 O 150
O 15 O None of these
- xiii). The difference of the largest and smallest value in the data is called
- O Mean O Mode
O Range O Standard deviation

xiv). The formula $\frac{\sum x}{n}$ determines

- O Arithmetic mean O Median
O Geometric mean O mode

xv). What is difference between mean of set B and median of set A

Set A: 2,-1,7,-4,11,3

Set B: 12,5,-3,4,7,-7

- O -0.5 O 0
O 0.5 O 1

xvi). $\frac{\sum f(x-\bar{x})^2}{\sum f}$ is called

- O Range O Median
O Mode O GM

xvii). The most frequent value in the data is called its.....

- O Mean O Median
O Mode O GM

Q2. The ages of 27 students of 10th class are given. Prepare a frequency distribution of suitable class interval.

17,17,16,16,17,16,16,17,18,18,15,17,19,18,18,
17,16,15,16,17,15,19,19,15,15,16,18.

Sol: Class size = 2

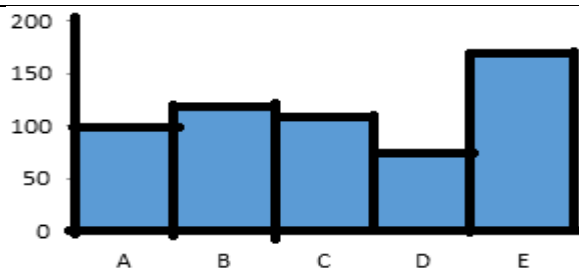
C.B	Tally	Frequency
15-16	15,15,15,15,15,16 16,16,16,16,16,16	12
17-18	17,17,17,17,17,17, 17,18,18,18,18,18	12
19-20	19,19,19	3

Q3: prepare a histogram of the following table

Brand Of car	A	B	C	D	E
Sale	100	120	110	72	169

Sol: Given data should be continuous i.e., A,B,C,D,E are continuous

Brand of car	Sale in 1 month
A	100
B	120
C	110
D	72
E	169

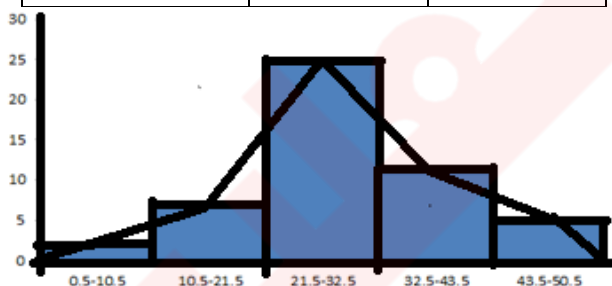


Q4: Prepare a frequency polygon of the following frequency distribution

Score in test	0-10	11-21	22-32	33-43	44-50
Sale	100	120	110	72	169

Sol:

Score in test	Boundaries	Frequency
0-10	0.5-10.5	2
11-21	10.5-21.5	7
22-32	21.5-32.5	25
33-43	32.5-43.5	11
44-50	43.5-50.5	5

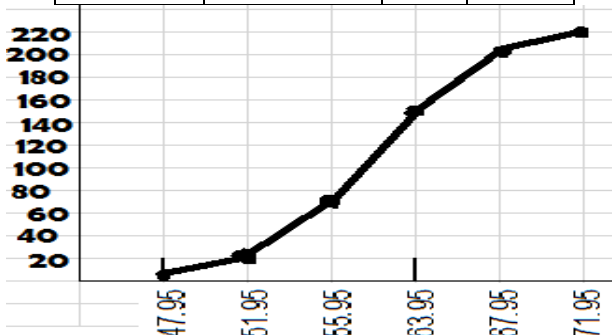


Q5. This table summaries the weights in kg of 250 boys. Represent these data by mean of cumulative frequency polygon.

Weight	44-47.9	48-51.9	52-55.9	56-59.9	60-63.9	64-67.9	68-71.9
Boys	3	17	50	81	57	23	9

Sol:

Weight	Boundaries	f	c.f
44.0-47.9	43.95-47.95	3	3
48.0-51.9	47.95-51.95	17	20
52.0-55.9	51.95-55.95	50	70
60.0-63.9	59.95-63.95	81	151
64.0-67.9	63.95-67.95	57	208
68.0-71.9	67.95-71.95	9	217

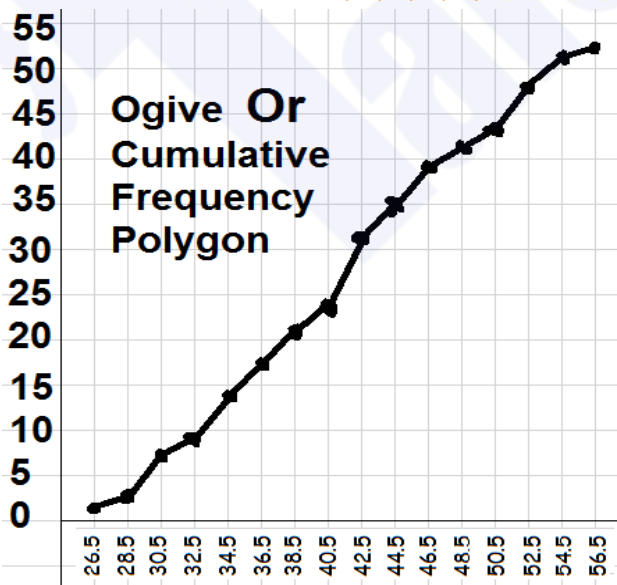
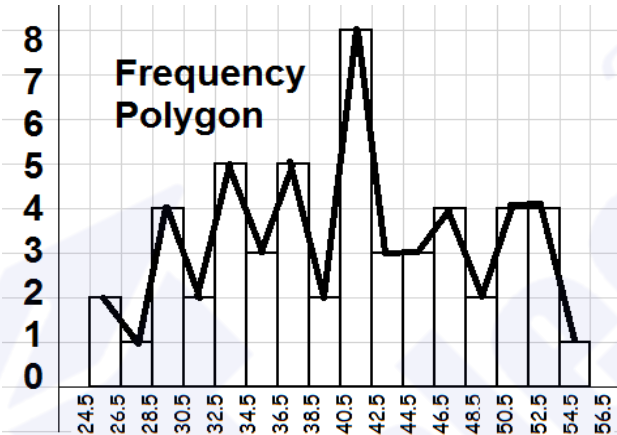
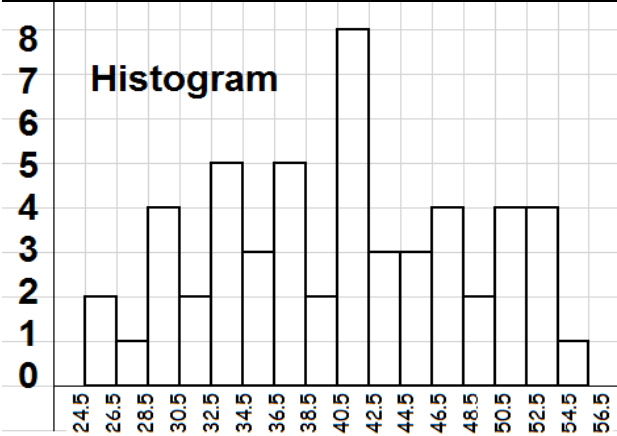


Q6: The following scores were made on a 60 items test; 25,30,34,37,41,42,46,49,53, 26,31,34,37,41,42,46,50,53,28,31,35,37,41, 43,47,51,54,29,33,36,38,41,44,48,52,54,30, 33,37,40,42,45,48,42

a). Group data into class interval of size 2

Class	Boundaries	Tally	f	c.f
25-26	24.5-26.5	25,26	2	2
27-28	25.5-28.5	28	1	3

29-30	27.5-30.5	29,30,30,30	4	7
31-32	30.5-32.5	31,31	2	9
33-34	32.5-34.5	33,33,33,34,34	5	14
35-36	34.5-36.5	35,36,36	3	17
37-38	36.5-38.5	37,37,37,37,38	5	22
39-40	38.5-40.5	39,40	2	24
41-42	40.5-42.5	41,41,41,41,41 42,42,42	8	32
43-44	42.5-44.5	43,44,44	3	35
45-46	44.5-46.5	45,46,46	3	38
47-48	46.5-48.5	47,48,48,48	4	42
49-50	48.5-50.5	49,50	2	44
51-52	50.5-52.5	51,52,52,52	4	48
53-54	52.5-54.5	53,53,54,54	4	52
55-56	54.5-56.5	55	1	53



Range = Maximum - minimum
Range = 55 - 25

Range = 30

For Mean, Variance and Standard Deviation

Class	x	f	$f.x$	x^2	$f.x^2$
25-26	25.5	2	51	650.25	1300.5
27-28	27.5	1	27.5	756.25	756.25
29-30	29.5	4	118	870.25	3481
31-32	31.5	2	63	992.25	1984.5
33-34	33.5	5	167.5	1122.25	5611.25
35-36	35.5	3	106.5	1260.25	3780.75
37-38	37.5	5	187.5	1406.25	7031.25
39-40	39.5	2	79	1560.25	3120.5
41-42	41.5	8	332	1722.25	13778
43-44	43.5	3	130.5	1892.25	5676.75
45-46	45.5	3	136.5	2070.25	6210.75
47-48	47.5	4	190	2256.25	9025
49-50	49.5	2	99	2450.25	4900.5
51-52	51.5	4	206	2652.25	10609
53-54	53.5	4	214	2862.25	11449
55-56	55.5	1	55.5	3080.25	3080.25
		53	2163.5		91795.25

$$\text{Sol: } \bar{x} = \frac{\sum f.x}{\sum f} = \frac{2163.5}{53}$$

$$\bar{x} = 40.82$$

$$\text{Variance} = \frac{\sum f.x^2}{\sum f} - \left(\frac{\sum f.x}{\sum f} \right)^2$$

$$S^2 = \frac{91795.25}{53} - \left(\frac{2163.5}{53} \right)^2$$

$$S^2 = \frac{91795.25}{53} - \left(\frac{2163.5}{53} \right)^2$$

$$S^2 = 1731.99 - (40.82)^2$$

$$S^2 = 1731.99 - 1666.27$$

$$S^2 = 65.72$$

$$\text{Standard Deviation} = \sqrt{\frac{\sum f.x^2}{\sum f} - \left(\frac{\sum f.x}{\sum f} \right)^2}$$

$$SD = \sqrt{\frac{91795.25}{53} - \left(\frac{2163.5}{53} \right)^2}$$

$$S.D = \sqrt{\frac{91795.25}{53} - \left(\frac{2163.5}{53} \right)^2}$$

$$S.D = \sqrt{1731.99 - (40.82)^2}$$

$$S.D = \sqrt{1731.99 - 1666.27}$$

$$S.D = \sqrt{65.72}$$

$$S.D = 8.11$$