Solution For Problemes On Probability and Statics

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***Abstract*—This document includes different problems and solution on probability and statics.It also provides the imformation about the python and latex codes of figures.**

Download all python codes from

```
svn co https://github.com/yogi13995/
    yogesh_training/tree/master/Geometry/
    probability/codes
```

and latex-tikz codes from

```
svn co https://github.com/yogi13995/
    yogesh_training/tree/master/Geometry/
    probability/figures
```

1 Probablity Example

1.1 Problem1

1.1.1 question:

1. A coin is tossed 1000 times with the following frequencies:
   Head : 455, Tail : 545
   Compute the probability for each event.

1.1.2 Solution:

1. given that →
   No of experiment = 1000
   No of heads = 455
   No of tails = 545
   probability of comming heads = P($X = 0$)

$$P(X=0) = \frac{455}{1000} \tag{1.1.1.1}$$
$$= 0.45 \tag{1.1.1.2}$$

2. probability of comming Tails = P($X = 1$)

$$P(X=1) = \frac{545}{1000} \tag{1.1.2.1}$$
$$= 0.545 \tag{1.1.2.2}$$

   codes for the above equation can be get from here

```
codes/probexm/probexm1.py
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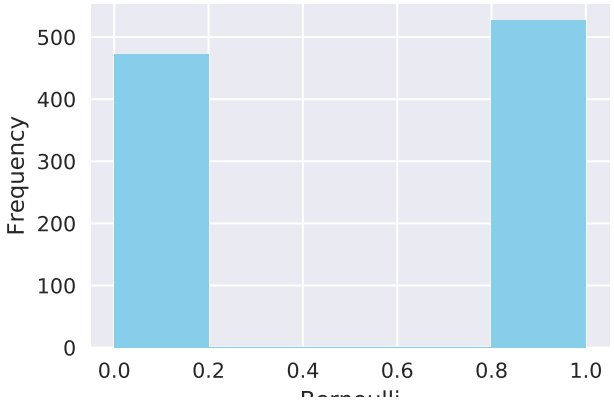

Fig. 1.1.2: bernoulli distribution of cointo be head

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figs/probexm/probexm1.eps
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1.2 Problem2

1.2.1 question:

1. Two coins are tossed simultaneously 500 times, and we get
   Two heads : 105 times
   One head : 275 times
   No head : 120 times
   Find the probability of occurrence of each of these events.

1.2.2 Solution:

1. given that →
   No of experiment = 500
   No of two heads = 105
   probability of one head = p(X=1)

$$P(X=1) = \frac{105}{500} \tag{1.2.1.1}$$
$$= 0.21 \tag{1.2.1.2}$$

2. No of one head = 275
   probability of two heads = p(X=2)

$$P(X=2) = \frac{275}{500} \tag{1.2.2.1}$$
$$= 0.55 \tag{1.2.2.2}$$

3. No of no head = 120
probability of no head = p(X=0)

$$P(X=0) = \frac{120}{500} \quad (1.2.3.1)$$
$$= 0.24 \quad (1.2.3.2)$$

1.3 Problem3

1.3.1 question:

1. A die is thrown 1000 times with the frequencies for the outcomes 1, 2, 3, 4, 5 and 6 as given in the following table :

Outcome	1	2	3
Frequency	179	150	157
Outcome	4	5	6
Frequency	149	175	190

Find the probability of getting each outcome

1.3.2 Solution:

1. NO of experiment = 1000
NO of experiment with output 1 on dice = 179
probability of outcome 1 = P(X=1)

$$P(X=1) = \frac{179}{1000} \quad (1.3.1.1)$$
$$= 0.179 \quad (1.3.1.2)$$

2. NO of experiment with output 2 on dice = 150
probability of outcome 2 = P(X=2)

$$P(X=2) = \frac{150}{1000} \quad (1.3.2.1)$$
$$= 0.15 \quad (1.3.2.2)$$

3. NO of experiment with output 3 on dice = 157
probability of outcome 3 = P(X=3)

$$P(X=3) = \frac{157}{1000} \quad (1.3.3.1)$$
$$= 0.157 \quad (1.3.3.2)$$

4. NO of experiment with output 4 on dice = 149
probability of outcome 4 = P(X=4)

codes/probexm/probexm3.py

$$P(D) = \frac{149}{1000} \quad (1.3.4.1)$$
$$= 0.149 \quad (1.3.4.2)$$

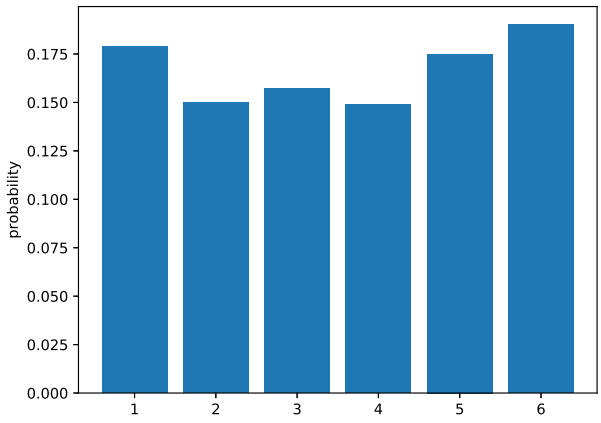

Fig. 1.3.4: probability of outcome of biased dice

figs/probexm/probexm3.eps

5. NO of experiment with output 5 on dice = 175
probability of outcome 5 = P(X=5)

$$P(X=5) = \frac{175}{1000} \quad (1.3.5.1)$$
$$= 0.175 \quad (1.3.5.2)$$

6. NO of experiment with output 6 on dice = 190
probability of outcome 6 = P(X=6)

$$P(X=6) = \frac{190}{1000} \quad (1.3.6.1)$$
$$= 0.19 \quad (1.3.6.2)$$

1.4 Problem4

1.4.1 question:

1. If you buy a tyre of this company, what is the probability that :
(i) it will need to be replaceOn one page of a telephone directory, there were 200 telephone numbers. The frequency distribution of their unit place digit (for example, in the number 25828573, the unit place digit is 3) is given in Table below :

Without looking at the page, the pencil is placed on one of these numbers, i.e., the number is chosen at random. What is the probability that the digit in its unit place is 6?

1.4.2 Solution:

1. given that →
friquency of no with unit digit 6 = 14

Digit	frequency
0	22
1	26
2	22
3	22
4	20
5	10
6	14
7	28
8	16
9	20

TABLE 1.4.1: friquency distribution table2

probability of unit digit to be 6 = P(X=6)

$$P(X=6) = \frac{14}{200} \tag{1.4.1.1}$$
$$= 0.07 \tag{1.4.1.2}$$

codes for the above equation can be get from here

codes/probexm/probexm4.py

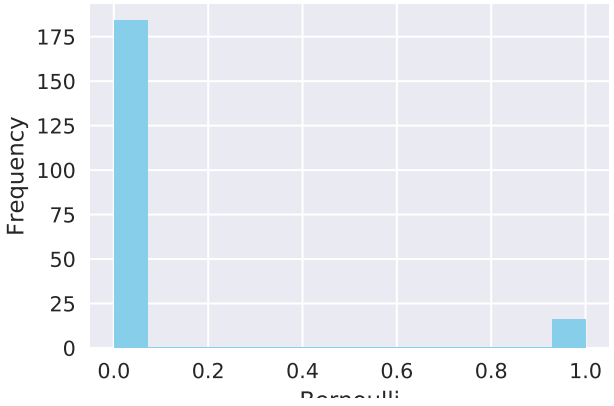

Fig. 1.4.1: bernoulli distribution of no to be 6

figs/probexm/probexm4.eps

1.5 Problem5

1.5.1 question:

1. The record of a weather station shows that out of the past 250 consecutive days, its weather forecasts were correct 175 times.
   (i) What is the probability that on a given day it was correct?
   (ii) What is the probability that it was not correct on a given day?

1.5.2 Solution:

1. given that→
   total no of record = 250
   No of correct forecast = 175
   probability of forecasr to be correct = P(X=1)

$$P(X=1) = \frac{175}{250} \tag{1.5.1.1}$$
$$= 0.7 \tag{1.5.1.2}$$

2. No of incorrect forecast = 75
   probability of forecasr to be incorrect = P(X=0)

$$P(X=0) = \frac{75}{250} \tag{1.5.2.1}$$
$$= 0.3 \tag{1.5.2.2}$$

1.6 Problem6

1.6.1 question:

1. A tyre manufacturing company kept a record of the distance covered before a tyre needed to be replaced. The table shows the results of 1000 cases.

Distance(in km)	> 4000	4000-9000
Frequency	20	210
Distance(in km)	9001-14000	<14000
Frequency	325	445

(i) What is the probability that a tyre will need to be replaced before it has covered 4000 km?
(ii) it will last more than 9000 km?
(iii) it will need to be replaced after it has covered somewhere between 4000 km and 14000 km?

1.6.2 Solution:

1. given that →
   No of cases = 1000
   No of cases when the tyre lasts more than 9000 Km = 325 + 445 = 770
   probability of a tyre lasts more than 9000 Km = $P(X > 9K)$

$$P(X > 9K) = \frac{770}{1000} \tag{1.6.1.1}$$
$$= 0.77 \tag{1.6.1.2}$$

2. No of cases when the tyre lasts betwwen 4000 to 14000 Km = 20+210+325=555
probability of a tyre lasts between 4000 to 14000 Km = $P(4K < X < 14K)$

$$P(4K < X < 14K) = \frac{555}{1000} \quad (1.6.2.1)$$
$$= 0.0.555 \quad (1.6.2.2)$$

3. No of cases when the tyre lasts less than 4000 Km = 20
probability of a tyre lasts less than 4000 Km = $P(X < 4K)$

$$P(X < 4K) = \frac{20}{1000} \quad (1.6.3.1)$$
$$= 0.02 \quad (1.6.3.2)$$

codes for the above equation can be get from here

codes/probexm/probexm6.py

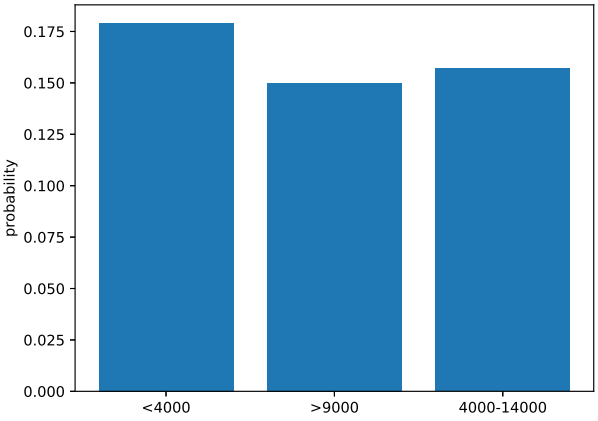

Fig. 1.6.3: probability of distance covered by tyre

figs/probexm/probexm6.eps

1.7 Problem7

1.7.1 question:

1. The percentage of marks obtained by a student in the monthly unit tests are given below:

Unit test	I	II	III
Frequency	69	71	73
Unit test	IV	V	
Frequency	68	74	

Based on this data, find the probability that the student gets more than 70% marks in a unit test.

1.7.2 Solution:

1. given that
Total no of unit tests = 5
no of tests having more than 70% = 3

$$P(X > 70) = \frac{3}{5} \quad (1.7.1.1)$$
$$= 0.6 \quad (1.7.1.2)$$

1.8 Problem8

1.8.1 question:

1. An insurance company selected 2000 drivers at random (i.e., without any preference of one driver over another) in a particular city to find a relationship between age and accidents. The data obtained are given in the following table: **??**

Age of drivers (in years)	**Accidents in one year**				
	0	**1**	**2**	**3**	**over 3**
18-29	440	160	110	61	35
30-50	505	125	60	22	18
Above 50	360	45	35	15	9

Find the probabilities of the following events for a driver chosen at random from the city:
(i) being 18-29 years of age *and* having exactly 3 accidents in one year.
(ii) being 30-50 years of age *and* having one or more accidents in a year.
(iii) having no accidents in one year

1.8.2 Solution:

1. Totalno of drivers taking part in survey = 2000
no of drivers in the age 18-29 and having 3 accidents in a year = 61
probability of drivers in the age 18-29 and having 3 accidents in a year = P(X=1)

$$P(X = 1) = \frac{61}{2000} \quad (1.8.1.1)$$
$$= 0.03 \quad (1.8.1.2)$$

2. no of drivers in the age 30-50 and having 1 or more accidents in a year = 125+60+22 = 207

probability of drivers in the age 30-50 and having 1 or more accidents in a year = P(X=2)

$$P(X=2) = \frac{207}{2000} \tag{1.8.2.1}$$
$$= 0.103 \tag{1.8.2.2}$$

3. no of drivers having no accidents in a year = 440+505+360=1305
probability of drivers having no accidents in a year = P(X=3)

$$P(X=3) = \frac{1305}{2000} \tag{1.8.3.1}$$
$$= 0.65 \tag{1.8.3.2}$$

codes for the above equation can be get from here

codes/probexm/probexm8.py

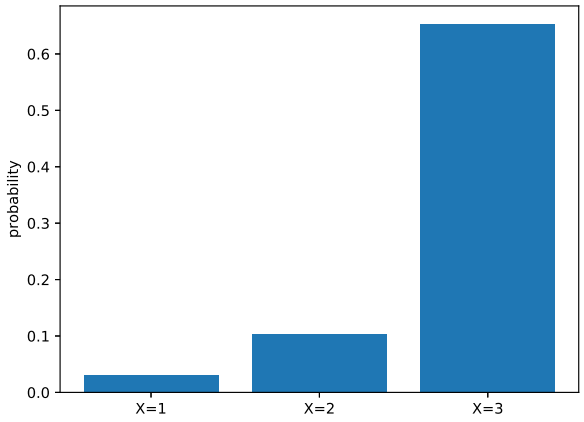

Fig. 1.8.3: probability ofaccident in an year

figs/probexm/probexm8.eps

1.9 Problem9

1.9.1 question:

1.
2. Consider the frequency distribution table below which gives the weights of 38 students of a class.

Weights (in kg)	Number of students
31-35	9
36-40	5
41-45	14
46-50	3
51-55	1
56-60	2
61-65	2
66-70	1
71-75	1
Total	38

(i) Find the probability that the weight of a student in the class lies in the interval 46-50 kg.
(ii) Give two events in this context, one having probability 0 and the other having probability 1.

1.9.2 Solution:

1. total no of students = 38
No of students whose weight lie in the range 46-50 = 3

probability of students whose weight lie in the range 46-50 = $P(46 < X50)$

$$P(A) = \frac{3}{38} \tag{1.9.1.1}$$
$$= 0.079 \tag{1.9.1.2}$$

2. There is no student whose weight is less than 31 kg thus the probability of a student to have the weight less than 31 kg = 0

All of the student in this context have the weight between 31-75 so we can say that the probability of the students to have the weight in the range 31-75 = 1

1.10 Problem10

1.10.1 question:

1. Fifty seeds were selected at random from each of 5 bags of seeds, and were kept under standardised conditions favourable to germination. After 20 days, the number of seeds which had germinated in each collection were counted and recorded as follows:

Bag	1	2	3
No.of seeds germinated	40	48	42
Bag	4	5	
No.of seeds germinated	39	41	

What is the probability of germination of
(i)more than 40 seeds in a bag?
(ii) 49 seeds in a bag?
(iii) more that 35 seeds in a bag?

1.10.2 Solution:

1. total no of bages = 5
   No of bages having 40 germinated seeds = 3

   probability of a bag having 40 germinated seeds = P(X=40)

$$P(X=40) = \frac{3}{5} \tag{1.10.1.1}$$
$$= 0.6 \tag{1.10.1.2}$$

   No of bages having 49 germinated seeds = 0

   probability of a bag having 49 germinated seeds = P(X=49)

$$P(X=49) = \frac{0}{5} \tag{1.10.1.3}$$
$$= 0 \tag{1.10.1.4}$$

   No of bages having more than 35 germinated seeds = 5

   probability of a bag having more than 35 germinated seeds = $P(X>35)$

$$P(X>35) = \frac{5}{5} \tag{1.10.1.5}$$
$$= 1 \tag{1.10.1.6}$$

   codes for the above equation can be get from here

codes/probexm/probexm10.py

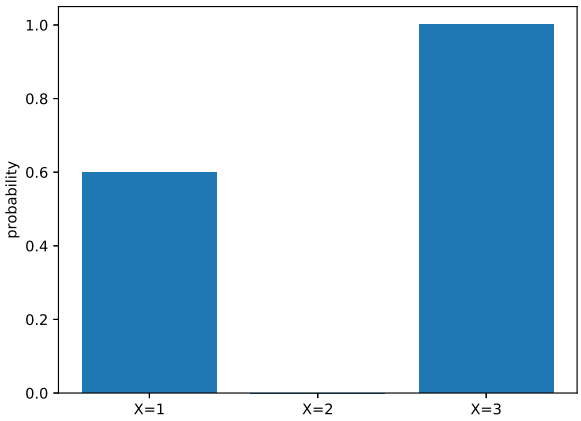

Fig. 1.10.1: probability of germinated seeds in a bag

figs/probexm/probexm10.eps

2 Probablity Excersise

2.1 Problem1

2.1.1 question:

1. In a cricket match, a batswoman hits a boundary 6 times out of 30 balls she plays. Find the probability that she did not hit a boundary.

2.1.2 Solution:

1. let assume $P(X=1)$ be the probability of hitting 6 so

$$\mathbf{P(X=1)} = \frac{6}{30} \tag{2.1.1.1}$$
$$= \frac{1}{5} \tag{2.1.1.2}$$

   $P(X=0)$ be the probability of not hitting the boundry

$$P(X=0) = 1 - P(A) \tag{2.1.1.3}$$
$$= 1 - \frac{1}{5} \tag{2.1.1.4}$$
$$= \frac{4}{5} \tag{2.1.1.5}$$

   codes for the above equation can be get from here

codes/prob/prob1.py

2.2 Problem2

2.2.1 question:

1. 1500 families with 2 children were selected randomly, and the following data were recorded:

No.of girls in a family	2	1	0
No. of families	475	814	211

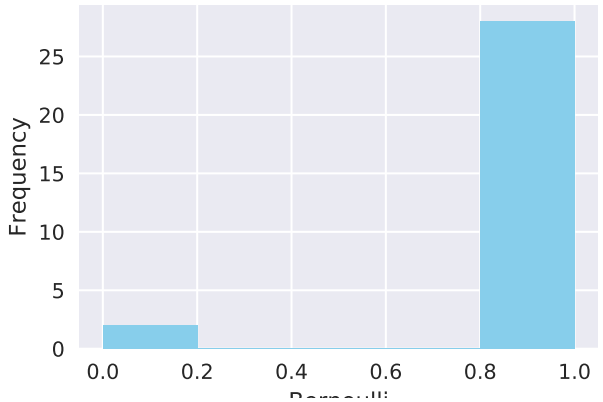

Fig. 2.1.1: bernoulli distribution1

codes/prob/prob1.py

Compute the probability of a family, chosen at random, having
(i)2 girls
(ii) 1 girl
(iii) No girl
Also check whether the sum of these probabilities is 1.

2.2.2 Solution:

1. probability of having two girls in a family

$$= \frac{\text{Favourable cases}}{\text{total cases}} \tag{2.2.1.1}$$

$$= \frac{\text{No. of families having 2 girls}}{\text{total No. of families}} \tag{2.2.1.2}$$

Let assume that the probability of chosen family will have 2 girls be $P(X=2)$ so

$$P(X=2) = \frac{475}{1500} \tag{2.2.1.3}$$

$$= 0.316 \tag{2.2.1.4}$$

2. probability of having one girl in a family

$$= \frac{\text{No. of families having 1 girl}}{\text{total No. of families}} \tag{2.2.2.1}$$

Let assume that the probability of chosen family will have 1 girl be $P(X=1)$ so

$$P(X=1) = \frac{814}{1500} \tag{2.2.2.2}$$

$$= 0.5427 \tag{2.2.2.3}$$

3. probability of having one girl in a family

$$= \frac{\text{No. of families having no girl}}{\text{total No. of families}} \tag{2.2.3.1}$$

Let assume that the probability of chosen family will have no girl be $P(X=0)$ so

$$P(X=0) = \frac{211}{1500} \tag{2.2.3.2}$$

$$= 0.1407 \tag{2.2.3.3}$$

$$P(X=2) + P(X=1) + P(X=0) = 0.316 + 0.5427 + 0.14 \tag{2.2.3.4}$$

$$= 1 \tag{2.2.3.5}$$

codes for the above equation can be get from here

codes/prob/prob2.py

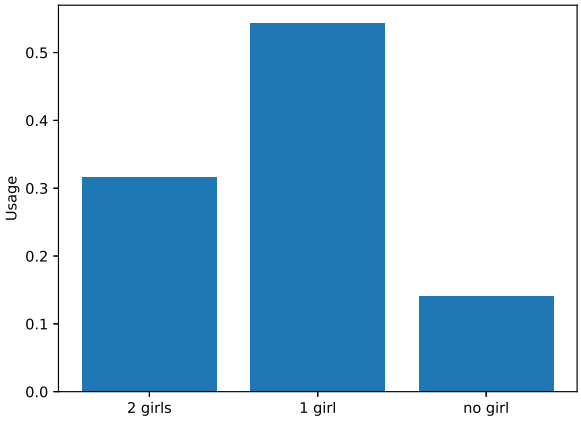

Fig. 2.2.3: probability 2

figs/prob/prob2.py

2.3 Problem3

2.3.1 question:

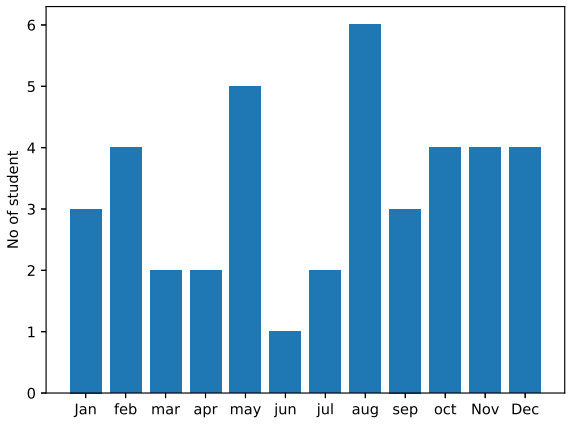

Fig. 2.3.0: student birth figure

1. Find the probability that a student of the class was born in August.

2.3.2 Solution:

1. Total no of the studend in a year = 40 no of student of class August = 6 let probabilaty of a student to be of august class be P(X=8)

$$P(X=8) = \frac{6}{40} \qquad = 0.15 \qquad (2.3.1.1)$$

codes for the above equation can be get from here

codes/prob/prob3.py

2.4 Problem4

2.4.1 question:

1. Three coins are tossed simultaneously 200 times with the following frequencies of different outcomes:

Outcome	3 heads	2 heads	1 head	No head
Frequency	23	72	77	28

If the three coins are simultaneously tossed again, compute the probability of 2 heads coming up.

2.4.2 Solution:

1. let probability of head when a single coin is tossed = p
let probability of tails when a single coin is tossed = q
probability of two head when three coins are tossed = P(X=2)

$$p = \frac{1}{2} \qquad (2.4.1.1)$$

$$q = \frac{1}{2} \qquad (2.4.1.2)$$

$$P(X=2) = {}^{n}C_{k} \times (p)^{n} (q)^{1-n} \text{ (binomial theoram)} \qquad (2.4.1.3)$$

$$P(X=2) = {}^{3}C_{2} \times \left(\frac{1}{2}\right)^{2} \left(\frac{1}{2}\right)^{1} \qquad (2.4.1.4)$$

$$= \frac{3}{8} \qquad (2.4.1.5)$$

codes for the above equation can be get from here

codes/prob/prob4.py

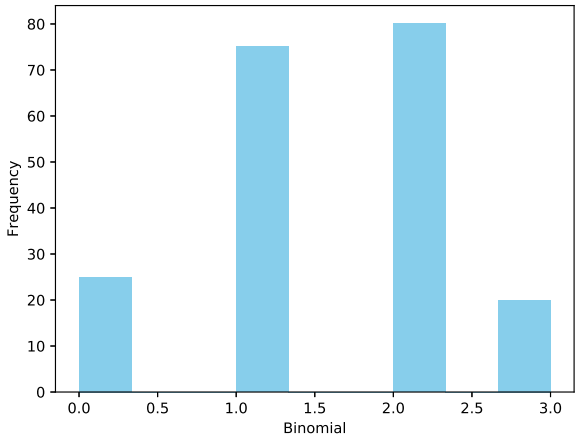

Fig. 2.4.1: binomial distribution of toss of three coins

figs/prob/prob4.py

2.5 Problem5

2.5.1 question:

1. Refer the table given below.

Marks	**Number of students**
0-20	7
20-30	10
30-40	10
40-50	20
50-60	20
60-70	15
70-above	8
Total	90

(i) Find the probability that a student obtained less than 20% in the mathematics test.
(ii) Find the probability that a student obtained marks 60 or above.

2.5.2 Solution:

1. Total n0 of student = 90
   no of students who obtained marks less than 20% = 7
   assume that $P(X < 20)$ is the probability of the students obtained less than 20% marks

$$P(X < 20) = \frac{7}{90} \tag{2.5.1.1}$$
$$= 0.07 \tag{2.5.1.2}$$

2. no of the students obtained 60-70 marks = 15
   no of the student obtained 70 above marks = 8
   $P(X \geq 60)$= probability of a student obtained 60 0r above marks

$$P(X \geq 60) = \frac{15 + 8}{90} \tag{2.5.2.1}$$
$$= 0.256 \tag{2.5.2.2}$$

codes/prob/prob5.py

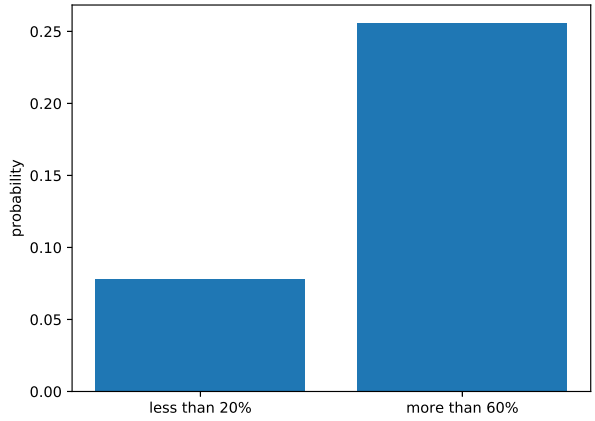

Fig. 2.5.2: probability of marks of students

figs/prob/prob5.py

2.6 Problem6

2.6.1 question:

1. To know the opinion of the students about the subject statistics, a survey of 200 students was conducted. The data is recorded in the following table.

Opinion	Number of students
like	135
dislike	65

Find the probability that a student chosen at random
(i)likes statistics,
(ii) does not like it.

2.6.2 Solution:

1. No of the total students participating the survey= 200
   students like the statics = 135
   P(X=1) = probability of student likes the statics

$$P(X = 1) = \frac{135}{200} \tag{2.6.1.1}$$
$$= 0.675 \tag{2.6.1.2}$$

2. No of students do not like the statics = 65
   P(X=0) = probability of student does not like the statics

$$P(X = 0) = \frac{65}{200} \quad = 0.325 \tag{2.6.2.1}$$

codes for the above equation can be get from here

codes/prob/prob6.py

2.7 Problem7

2.7.1 question:

1. Refer the table below

5	3	10	20	25	11	13	7	12	31
19	10	12	17	18	11	32	17	16	2
7	9	7	8	3	5	12	15	18	3
12	14	2	9	6	15	15	7	6	12

What is the empirical probability that an engineer lives:
(i) less than 7 km from her place of work?
(ii)more than or equal to 7 km from her place of work?

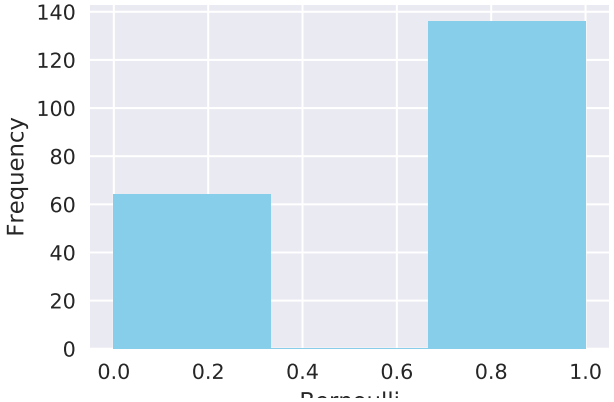

Fig. 2.6.2: bernouli distribution of students liking statics

figs/prob/prob6.py

(iii) within $\frac{1}{2}$km from her place of work?

2.7.2 Solution:

1. total no of people working at the work place = 40 no of people live less than 7km from the work place = 9 let probability of a emgineer livinf less than 7 km from workplace = $P(< 7)$

$$P(X < 7) = \frac{9}{40} \tag{2.7.1.1}$$

2. no of people live more than or equal 7km from the work place = 31 let probability of a emgineer livinf less than 7 km from workplace = $P(X \geq 7)$

$$P(X \geq 7) = \frac{31}{40} \tag{2.7.2.1}$$

3. there is no one who live within $\frac{1}{2}$ km from the work place so the probability will be 0.
   codes for the above equation can be get from here

codes/prob/prob7.py

2.8 Problem8

2.8.1 question:

1. An organisation selected 2400 families at random and surveyed them to determine a relationship between income level and the number of vehicles in a family. The information gathered is listed in the table:

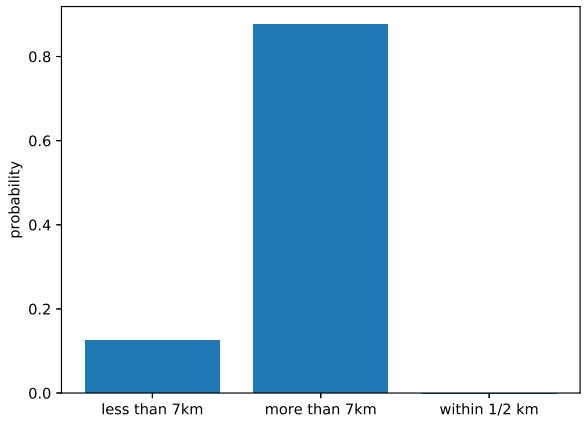

Fig. 2.7.3: probabilities a man to be near from work place

figs/prob/prob7.py

Monthly income (in ₹)	**vehicles per family**			
	0	**1**	**2**	**Above 2**
Less than 7000	10	160	25	0
7000-10000	0	305	27	2
10000-13000	1	535	29	1
13000-16000	2	469	59	25
16000 or more	1	579	82	88

??

Suppose a family is chosen.Find the probability that the family chosen is
(i) earning ₹10000 ₹13000 per month and owning exactly 2 vehicles.
(ii) earning ₹16000 or more per month and owning exactly 1 vehicle.
(iii) earning less than ₹7000 per month and does not own any vehicle.
(iv) earning ₹13000 ₹16000 per month and owning more than 2 vehicles.
(v) owning not more than 1 vehicle.

2.8.2 Solution:

1. no of total families chosen for survey = 2400
   No of families owning 2 vehicles and earning of ₹10000 - ₹13000 per month = 1

$$P(X = 1) = \frac{29}{2400} \quad = 0.012 \tag{2.8.1.1}$$

2. No of families earning ₹16000 and more per

month and owning exactly 1 vehicle = 579
P(X=2) = probability of a family to have 1 vehicle with earning of ₹16000 and more

$$P(X=2) = \frac{579}{2400} \quad (2.8.2.1)$$
$$= 0.241 \quad (2.8.2.2)$$

3. No of families earning less than ₹7000 per month and owning exactly no vehicle = 10
P(X=3) = probability of a family to have no vehicle with earning less than ₹7000

$$P(X=3) = \frac{10}{2400} \quad (2.8.3.1)$$
$$= 0.0042 \quad (2.8.3.2)$$

4. No of families earning ₹13000 to ₹16000 per month and owning more than 2 vehicle = 25
P(D) = probability of a family to have more than 2 vehicles with earning ₹13000 to ₹16000 per month

$$P(X=4) = \frac{25}{2400} \quad (2.8.4.1)$$
$$= 0.0104 \quad (2.8.4.2)$$

5. No of families owning not more than 1 vehicle →
earning less than ₹7000 = 170
earning ₹7000 to ₹10000 = 305
earning ₹7000 to ₹10000 = 536
earning ₹7000 to ₹10000 = 471
earning ₹7000 to ₹10000 = 580
total no of families = 1892

P(X=5) = probability of a family to have not more than 1vehicle

$$P(X=5) = \frac{1892}{2400} \quad (2.8.5.1)$$
$$= 0.78833 \quad (2.8.5.2)$$

codes for the above equation can be get from here

codes/prob/prob8.py

2.9 Problem9

2.9.1 question:

1. Eleven bags of wheat flour, each marked 5 kg, actually contained the following weights of flour (in kg):
4.97 5.05 5.08 5.03 5.00 5.06 5.08 4.98 5.04 5.07 5.00
Find the probability that any of these bags chosen at random contains more than 5 kg of flour.

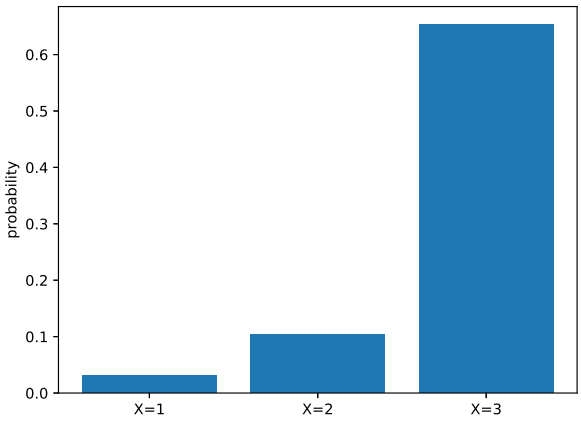

Fig. 2.8.5: probability of distance covered by tyre

figs/probexm/probexm8.eps

2.9.2 Solution:

1. No of bags having weight more than 5 Kg = 7
total no of bags = 11

$$P(X>5) = \frac{7}{11} \quad (2.9.1.1)$$
$$= 0.636 \quad (2.9.1.2)$$

codes for the above equation can be get from here

codes/prob/prob9.py

2.10 Problem10

2.10.1 question:

1. Prepare a frequency distribution table, regarding the concentration of sulphur dioxide in the air in parts per million of a certain city for 30 days.

0.03	0.08	0.08	0.09	0.04	0.17
0.16	0.05	0.02	0.06	0.18	0.20
0.11	0.08	0.12	0.13	0.22	0.07
0.08	0.01	0.10	0.06	0.09	0.18
0.11	0.07	0.05	0.07	0.01	10.04

Using this table, find the probability of the

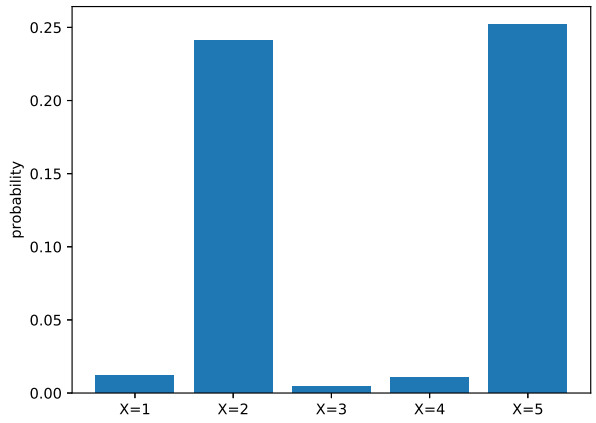

Fig. 2.9.1: probability of bag to be more than 5 Kg

figs/prob/prob9.py

concentration of sulphur dioxide in the interval 0.12 - 0.16 on any of these days.

2.10.2 Solution: =

1. P(A) be the prbability of concentration of sulpher

concentration of sulphur	friquency
0.01	2
0.02	1
0.03	1
0.04	2
0.05	2
0.06	2
0.07	3
0.08	4
0.09	2
0.10	1
0.11	2
0.12	1
0.13	1
0.16	1
0.17	1
0.18	2
0.20	1
0.22	1

TABLE 2.10.1: This is a table template

$$p\,(0.12 < X < 0.16) = \frac{1+1+1}{30} \quad (2.10.1.1)$$

$$= 0.1 \quad (2.10.1.2)$$

codes for the above equation can be get from here

codes/prob/prob10.py

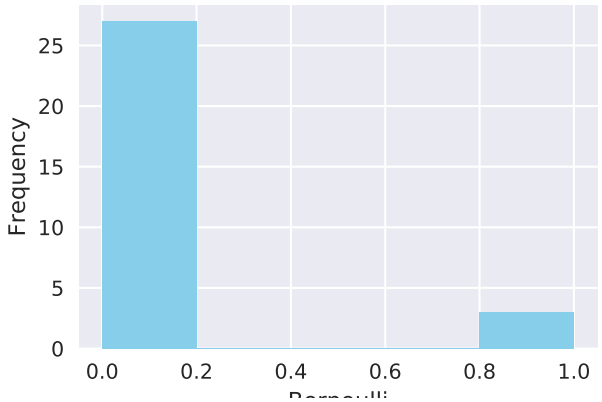

Fig. 2.10.1: probability of SO_2 0.12 to 0.16

figs/prob/prob10.py

3 Statics examples

3.1 Problem1

3.1.1 question:

1. The marks obtained by 30 students of Class X of a certain school in a Mathematics paper consisting of 100 marks are presented in table below. Find the mean of the marks obtained by the students.

3.1.2 Solution: renewcommand1.01

1.

$$\sum f = 30 \quad (3.1.1.1)$$

$$\sum f.x = 1779 \quad (3.1.1.2)$$

$$Mean = \frac{\sum f.x}{\sum f} \quad (3.1.1.3)$$

$$= \frac{1761}{30} \quad (3.1.1.4)$$

$$= 59.3 \quad (3.1.1.5)$$

codes for the above equations can be get from

marks obtained	No of students
10	1
20	1
36	3
40	4
50	3
56	2
60	4
70	4
72	1
80	1
88	2
92	3
95	1

TABLE 3.1.1: Table for marks of students

codes/statexm/statexm1.py

3.2 Problem2

3.2.1 question:

1.
2. The table below gives the percentage distribution of female teachers in the primary schools of rural areas of various states and union territories (U.T.) of India. Find the mean percentage of female teachers by all the three methods discussed in this section.

   Source : Seventh All India School Education Survey conducted by NCERT

Percentage of female teachers	No of states
15-25	6
25-35	11
35-45	7
45-55	4
55-65	4
65-75	2
75-85	1

TABLE 3.2.2: Table for female distribution in states

3.2.2 Solution:

1. Direct methode

Percentage of female teachers	midpoint (x)	No of states	f.x
15-25	20	6	120
25-35	30	11	330
35-45	40	7	280
45-55	50	4	200
55-65	60	4	240
65-75	70	2	140
75-85	80	1	80

d = x-50	u = x-50/10	f.d	f.u
-30	-3	-180	-18
-20	-2	-220	-22
-10	-1	-70	-7
0	0	0	0
10	1	40	4
20	2	40	4
30	3	30	3

TABLE 3.2.1: Friquency distribution table for female teachers

$$\sum f = 35 \tag{3.2.1.1}$$

$$\sum f.x = 1390 \tag{3.2.1.2}$$

$$Mean = \frac{\sum f.x}{\sum f} \tag{3.2.1.3}$$

$$= \frac{1390}{35} \tag{3.2.1.4}$$

$$= 39.71 \tag{3.2.1.5}$$

2. assumed mean methode

$$a = 50 \tag{3.2.2.1}$$

$$\sum f.d = -360 \tag{3.2.2.2}$$

$$Mean = a + \frac{\sum f.d}{\sum f} \tag{3.2.2.3}$$

$$= 39.71 \tag{3.2.2.4}$$

3. step devition method

$$h = 10 \tag{3.2.3.1}$$
$$\sum f.u = -36 \tag{3.2.3.2}$$
$$Mean = a + \frac{\sum f.u}{\sum f} \tag{3.2.3.3}$$
$$Mean = 50 + \frac{\sum -36}{\sum 35} \tag{3.2.3.4}$$
$$= 39.71 \tag{3.2.3.5}$$

codes for the above equations can be get from

codes/statexm/statexm2.py

3.3 Problem3

3.3.1 question:

1. The distribution below shows the number of wickets taken by bowlers in one-day cricket matches. Find the mean number of wickets by choosing a suitable method. What does the mean signify?

No of wickets	No of bowlers
20-60	7
60-100	5
100-150	16
150-250	12
250-350	2
350-450	3

TABLE 3.3.1: Table for wickets taken by bowler

3.3.2 Solution:

No of wickets	midpoints (x)	No of bowlers (f)	f.x
20-60	40	7	280
60-100	80	5	400
100-150	125	16	2000
150-250	200	12	2400
250-350	300	2	600
350-450	400	3	1200

TABLE 3.3.1: friquency distribution for wicket taken by baelwers

1.

$$\sum f = 45 \tag{3.3.1.1}$$
$$\sum f.x = 6880 \tag{3.3.1.2}$$
$$Mean = \frac{\sum f.x}{\sum f} \tag{3.3.1.3}$$
$$= \frac{6880}{45} \tag{3.3.1.4}$$
$$= 152.9 \tag{3.3.1.5}$$

codes for the above equations can be get from

codes/statexm/statexm2.py

3.4 Problem4

3.4.1 question:

1. The wickets taken by a bowler in 10 cricket matches are as follows:
   2 6 4 5 0 2 1 3 2 3
   Find the mode of the data.

3.4.2 Solution:

1. From the above table we can see that the friquency of the 2 is 3 which is more than any other no so the mode of the given data is 2.
   codes for the above equations can be get from

codes/statexm/statexm4.py

3.5 Problem5

3.5.1 question:

1. A survey conducted on 20 households in a locality by a group of students resulted in the following frequency table for the number of family members in a household:

Family size	1-3	3-5	5-7
Number of families	7	8	2
Family size	7-9	9-11	
Number of families	2	1	

Find the mode of this data

3.5.2 Solution:

1. in this table max friquency is 8 and modal class related to it is 3-5.

$$l = 3 \tag{3.5.1.1}$$
$$h = 2 \tag{3.5.1.2}$$
$$f_1 = 8 \tag{3.5.1.3}$$
$$f_0 = 7 \tag{3.5.1.4}$$
$$f_2 = 2 \tag{3.5.1.5}$$
$$Mode = l + \frac{f_1 - f_o}{2f_1 - f_o - f_2} \times h \tag{3.5.1.6}$$
$$= 3 + \frac{8-7}{2\times 8 - 7 - 2} \times 2 \tag{3.5.1.7}$$
$$= 3.28 \tag{3.5.1.8}$$

codes for the above equation can be get from here

codes/static5.py

3.6 Problem6

3.6.1 question:

1. The marks distribution of 30 students in a mathematics examination are given in Table below. Find the mode of this data. Also compare and interpret the mode and the mean.

Class interval	No of student
10-25	2
25-40	3
40-55	7
55-70	6
70-85	6
85-100	6

3.6.2 Solution:

1.

$$\sum f = 30 \tag{3.6.1.1}$$
$$\sum f.x = 1860 \tag{3.6.1.2}$$
$$Mean = \frac{\sum f.x}{\sum f} \tag{3.6.1.3}$$
$$= \frac{1860}{30} \tag{3.6.1.4}$$
$$= 62 \tag{3.6.1.5}$$

Class interval	No of student	midpoint (x)	f.x
10-25	2	17.5	35
25-40	3	32.5	97.5
40-55	7	47.5	332.5
55-70	6	62.5	375
70-85	6	77.5	465
85-100	6	92.5	555

TABLE 3.6.1: friqustion distribution of marks in maths

2. in this table max friquency is 8 and modal class related to it is 3-5.

$$l = 40 \tag{3.6.2.1}$$
$$h = 15 \tag{3.6.2.2}$$
$$f_1 = 3 \tag{3.6.2.3}$$
$$f_0 = 7 \tag{3.6.2.4}$$
$$f_2 = 6 \tag{3.6.2.5}$$
$$Mode = l + \frac{f_1 - f_o}{2f_1 - f_o - f_2} \times h \tag{3.6.2.6}$$
$$= 40 + \frac{7-3}{2\times 7 - 6 - 3} \times 2 \tag{3.6.2.7}$$
$$= 52 \tag{3.6.2.8}$$

codes for the above equation can be get from here

codes/statexm/sataexm6.py

3.7 Problem7

3.7.1 question:

1. A survey regarding the heights (in cm) of 51 girls of Class X of a school was conducted and the following data was obtained:

find the median height.

3.7.2 Solution:

1.

$$Median = l + \frac{\frac{n}{2} - cf}{f} \times h \tag{3.7.1.1}$$

total no of girls n = 51
n/2 = 25.5
nearest class to the middle comulative

Height(in cm)	No of girls
<140	4
< 145	11
< 150	29
< 155	40
<160	46
< 165	51

Height(in cm)	No of girls (cf)	frequency (f)
<140	4	4
140-145	11	7
145-150	29	18
150-155	40	11
155-160	46	6
160-165	51	5

TABLE 3.7.1: friquency distribution of hight of girls

friquency 25.5 = 145-150
lower limit l = 145
friquency of preceding class $f_2 = 11$
f = 18
h = 5

$$Median = 145 + \frac{25.5 - 11}{18} \times 5 \quad = 149.03 \tag{3.7.1.2}$$

codes for the above equations can be get from

codes/statexm/statexm7.py

3.8 Problem8

3.8.1 question:

1. The median of the following data is 525. Find the values of x and y, if the total frequency is 100.

3.8.2 Solution:

1. n = 100
implies

$$76 + x + y = 100 \tag{3.8.1.1}$$
$$x + y = 24 \tag{3.8.1.2}$$

class interval	frequency
0-100	2
100-200	5
200-300	x
300-400	12
400-500	17
500-600	20
600-700	y
700-800	9
800-900	7
900-1000	4

class interval	frequency	cumulitive friquency
0-100	2	2
100-200	5	7
200-300	x	7 + x
300-400	12	19 + x
400-500	17	36 +x
500-600	20	56 + x
600-700	y	56 +x+y
700-800	9	65+x+y
800-900	7	72+x+y
900-1000	4	76+x+y

TABLE 3.8.1: friquency distribution table

class related to the Median 525 = 500-600 from anove we can say that

$$l = 500 \tag{3.8.1.3}$$
$$h = 100 \tag{3.8.1.4}$$
$$f = 20 \tag{3.8.1.5}$$
$$cf = 36 + x \tag{3.8.1.6}$$
$$Median = l + \frac{\frac{n}{2} - cf}{f} \times h \tag{3.8.1.7}$$
$$525 = 500 + \frac{50 - 36 - x}{f} \times 100 \tag{3.8.1.8}$$
$$25 = 70 - 5x \tag{3.8.1.9}$$
$$x = 9 \tag{3.8.1.10}$$

from eq 3.8.1.2 and 3.8.1.10

$$9 + y = 24 \quad (3.8.1.11)$$

$$y = 15 \quad (3.8.1.12)$$

codes for the above equations can be get from

codes/statexm/statexm8.py

3.9 Problem9

3.9.1 question:

1. The annual profits earned by 30 shops of a shopping complex in a locality give rise to the following distribution: Draw both ogives for

profit	frequency
more than or equal to 5	30
more than or equal to 10	28
more than or equal to 15	16
more than or equal to 20	14
more than or equal to 25	10
more than or equal to 30	7
more than or equal to 35	3

the data above and obtain median profit

3.9.2 Solution:

1.
2. we can get the mdian by using the ogive graphs.Two types of ogive graphs are used in this method one is less than type ogive and other one is more than type ogive.

3. Less than type ogive graph is drawn by using the coordinates of lower limit of class and corresponding comulative frequency.

profit	frequency	c.f
5-10	2	2
10-15	12	14
15-20	2	16
20-25	4	20
25-30	3	23
30-35	4	27
35-40	3	30

TABLE 3.9.1: friquency distribution for profit of shops

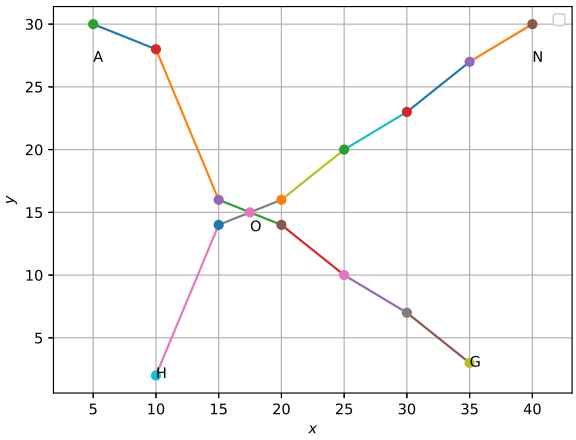

Fig. 3.9.3: less than and more than ogives

figure/statexm/statexm9.eps

4. More than type ogive graph is drawn by using coordinates of upper limit of class and corresponding cumulative frequency.

5. the crossing point of the both graph will give 'Median' and in above question it can be given by (17.5,15).
   codes for the above equations can be get from

codes/statexm/statexm9.py

3.10 Problem10

3.10.1 question:

1. COnsider the marks obtained by 10 students in a mathematics test as given below:

42,25,78,75,62,55,36,95,73,60 find the highest and the lowest marks?

3.10.2 Solution:

1. Highest marks = 95 Lowest marks = 25

4 Statics excersise

4.1 Problem1

4.1.1 question:

1. A survey was conducted by a group of students as a part of their environment awareness programme, in which they collected the following data regarding the number of plants in 20 houses in a locality. Find the mean number of plants per house.

4.1.2 Solution:

No of houses	No of houses	midpoints	fx
0-2	1	1	1
2-4	2	3	6
4-6	1	5	5
6-8	5	7	35
8-10	6	9	54
10-12	2	11	22
12-14	3	13	39

TABLE 4.1.1: friquency distribution table1

1.

$$\sum f = 20 \tag{4.1.1.1}$$

$$\sum f.x = 162 \tag{4.1.1.2}$$

$$Mean = \frac{\sum f.x}{\sum f} \tag{4.1.1.3}$$

$$= \frac{162}{20} \tag{4.1.1.4}$$

$$= 8.1 \tag{4.1.1.5}$$

codes for the above equations can be get from

codes/static1.py

4.2 Problem2

4.2.1 question:

1. Consider the following distribution of daily wages of 50 workers of a factory. Find the mean daily wages of the workers of the factory by using an appropriate method.

Daily wages	500-520	520-540	540-560
No of workers	12	14	8
Daily wages	560-580	580-600	
No of workers	6	10	

4.2.2 Solution:

Daily wages	No of workers	midpoints	f.x
500-520	12	510	6120
520-540	14	530	7420
540-560	8	550	4400
560-580	6	570	3420
580-600	10	590	5900

TABLE 4.2.1: friquency distribution table2

1.

$$\sum f = 50 \tag{4.2.1.1}$$

$$\sum f.x = 27260 \tag{4.2.1.2}$$

$$Mean = \frac{\sum f.x}{\sum f} \tag{4.2.1.3}$$

$$= \frac{27260}{50} \tag{4.2.1.4}$$

$$= 545.2 \tag{4.2.1.5}$$

codes for the above equations can be get from

codes/static2.py

4.3 Problem3

4.3.1 question:

1. The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is Rs 18. Find the missing frequency f.

4.3.2 Solution:

pocket allowance	11-13	13-15	15-17	17-19
Number of children	7	6	9	13
pocket allowance	19-21	21-23	23-25	
Number of children	f	5	4	

pocket allowences	No of children	midpoints	f.x
11-13	7	12	84
13-15	6	14	84
15-17	9	16	144
17-19	13	18	234
19-21	f	20	20f
21-23	5	22	110
23-25	4	24	96

TABLE 4.3.1: friquency distribution table3

1.

$$\sum f = 50 + f \tag{4.3.1.1}$$

$$\sum f.x = 752 + 20f \tag{4.3.1.2}$$

$$Mean = \frac{\sum f.x}{\sum f} \tag{4.3.1.3}$$

$$18 = \frac{752 + 20f}{44 + f} \tag{4.3.1.4}$$

$$f = 20 \tag{4.3.1.5}$$

codes for the above equations can be get from

codes/static3.py

4.4 Problem4

4.4.1 question:

1. Thirty women were examined in a hospital by a doctor and the number of heartbeats per minute were recorded and summarised as follows. Find the mean heartbeats per minute for these women, choosing a suitable method.

4.4.2 Solution:

No. of heartbeats	65-68	68-71	71-74	74-77
No. of women	2	4	3	8
No. of heartbeats	77-80	80-83	83-86	
No. of women	7	4	2	

No of heart-beats	No of women	midpoints	f.x
65-68	2	66.5	133
68-71	4	69.5	278
71-74	3	72.5	217.5
74-77	8	75.5	604
77-80	7	78.5	549.5
80-83	4	81.5	326
83-86	2	84.5	169

TABLE 4.4.1: friquency distribution table4

1.

$$\sum f = 30 \tag{4.4.1.1}$$

$$\sum f.x = 2277 \tag{4.4.1.2}$$

$$Mean = \frac{\sum f.x}{\sum f} \tag{4.4.1.3}$$

$$= \frac{2277}{30} \tag{4.4.1.4}$$

$$= 75.9 \tag{4.4.1.5}$$

codes for the above equations can be get from

codes/static4.py

4.5 Problem5

4.5.1 question:

1. In a retail market, fruit vendors were selling mangoes kept in packing boxes. These boxes contained varying number of mangoes. The following was the distribution of mangoes according to the number of boxes.

No of mangoes	50-52	53-55	56-58
No of boxes	15	110	135
No of mangoes	59-61	62-64	
No of boxes	115	25	

Find the mean number of mangoes kept in a packing box. Which method of finding the mean did you choose?

4.5.2 Solution:

No of mangoes	No of boxes	midpoints	f.x
50-52	15	51	765
53-55	110	54	5940
56-58	135	57	7695
59-61	115	60	6900
62-64	25	63	1575

TABLE 4.5.1: friquency distribution table5

1.

$$\sum f = 400 \tag{4.5.1.1}$$
$$\sum f.x = 22875 \tag{4.5.1.2}$$
$$Mean = \frac{\sum f.x}{\sum f} \tag{4.5.1.3}$$
$$= \frac{22875}{400} \tag{4.5.1.4}$$
$$= 57.19 \tag{4.5.1.5}$$

codes for the above equations can be get from

codes/static5.py

4.6 Problem6

4.6.1 question:

1. The table below shows the daily expenditure on food of 25 households in a locality. Find the

Daily expenditure	100-150	150-200	200-250
No of households	4	5	12
Daily expenditure	250-300	300-350	
No of households	2	2	

mean daily expenditure on food by a suitable method.

daily expenditure	No of households	midpoints	f.x
100-150	4	125	500
150-200	5	175	875
200-250	12	225	2700
250-300	2	275	550
300-350	2	325	650

TABLE 4.6.1: friquency distribution table6

4.6.2 Solution:

1.

$$\sum f = 25 \tag{4.6.1.1}$$
$$\sum f.x = 5275 \tag{4.6.1.2}$$
$$Mean = \frac{\sum f.x}{\sum f} \tag{4.6.1.3}$$
$$= \frac{5275}{25} \tag{4.6.1.4}$$
$$= 211 \tag{4.6.1.5}$$

codes for the above equations can be get from

codes/static6.py

4.7 Problem7

4.7.1 question:

1. To find out the concentration of so_2 in the air (in parts per million, i.e., ppm), the data was collected for 30 localities in a certain city and is presented below:

Concentration SO_2(in ppm)	0.00-0.04	0.04-0.08	0.08-0.12
Frequency	4	9	9
Concentration SO_2(in ppm)	0.12-0.16	0.16-0.20	0.20-0.24
Frequency	2	4	2

Find the mean concentration of SO_2 in the air.

4.7.2 Solution:

concen-tration of SO2	friquency	midpoints	f.x
0.00-0.04	4	0.02	0.08
0.04-0.08	9	0.06	0.54
0.08-0.12	9	0.1	0.9
0.12-0.16	2	0.14	0.28
0.16-0.20	4	0.18	0.72
0.20-0.24	2	0.22	0.44

TABLE 4.7.1: friquency distribution table7

1.

$$\sum f = 30 \tag{4.7.1.1}$$
$$\sum f.x = 2.96 \tag{4.7.1.2}$$
$$Mean = \frac{\sum f.x}{\sum f} \tag{4.7.1.3}$$
$$= \frac{2.96}{30} \tag{4.7.1.4}$$
$$= 0.099 \tag{4.7.1.5}$$

codes for the above equations can be get from

codes/static7.py

4.8 Problem8

4.8.1 question:

1. A class teacher has the following absentee record of 40 students of a class for the whole term. Find the mean number of days a student was absent.

No of days	0-6	6-10	10-14	14-20
No of students	11	10	7	4
No of days	20-28	28-38	38-40	
No of students	4	3	1	

4.8.2 Solution:

No of days	No of students	midpoints	f.x
0-6	11	3	33
6-10	10	8	80
10-14	7	12	84
14-20	4	16	64
20-28	4	24	96
28-38	3	33	99
38-40	1	39	39

TABLE 4.8.1: friquency distribution table8

1.

$$\sum f = 40 \tag{4.8.1.1}$$
$$\sum f.x = 495 \tag{4.8.1.2}$$
$$Mean = \frac{\sum f.x}{\sum f} \tag{4.8.1.3}$$
$$= \frac{495}{40} \tag{4.8.1.4}$$
$$= 12.37 \tag{4.8.1.5}$$

codes for the above equations can be get from

codes/static8.py

4.9 Problem9

4.9.1 question:

1. The following table gives the literacy rate (in percentage) of 35 cities. Find the mean literacy rate.

literacy(in percentage)	45-55	55-65	65-75
Number of cities	3	10	11
literacy(in percentage)	75-85	85-95	
Number of cities	8	3	

4.9.2 Solution:

1.

$$\sum f = 35 \tag{4.9.1.1}$$
$$\sum f.x = 2430 \tag{4.9.1.2}$$
$$Mean = \frac{\sum f.x}{\sum f} \tag{4.9.1.3}$$
$$= \frac{2430}{35} \tag{4.9.1.4}$$
$$= 69.42 \tag{4.9.1.5}$$

literacy	No of cities	midpoints	f.x
45-55	3	50	150
55-65	10	60	600
65-75	11	70	770
75-85	8	80	640
85-95	3	90	270

TABLE 4.9.1: friquency distribution table9

codes/static9.py

4.10 Problem10

4.10.1 question:

1. The following table shows the ages of the patients admitted in a hospital during a year:

Age (in years)	5-15	15-25	25-35
Number of patients	6	11	21
Age (in years)	35-45	45-55	55-65
Number of patients	23	14	5

Find the mode and the mean of the data given above. Compare and interpret the two measures of central tendency.

4.10.2 Solution:

Age	No of patient	midpoints	fx
5-15	6	10	60
15-25	11	20	220
25-35	21	30	630
35-45	23	40	920
45-55	14	50	700
55-65	5	60	300

TABLE 4.10.1: friquency distribution table10

1.

$$\sum f = 80 \tag{4.10.1.1}$$

$$\sum f.x = 2830 \tag{4.10.1.2}$$

$$Mean = \frac{\sum f.x}{\sum f} \tag{4.10.1.3}$$

$$= \frac{2830}{801} \tag{4.10.1.4}$$

$$= 35.375 \tag{4.10.1.5}$$

2. in this table max friquency is 23 and modal class related to it is 35-45.

$$l = 35 \tag{4.10.2.1}$$

$$h = 10 \tag{4.10.2.2}$$

$$f_1 = 23 \tag{4.10.2.3}$$

$$f_0 = 21 \tag{4.10.2.4}$$

$$f_2 = 14 \tag{4.10.2.5}$$

$$Mode = l + \frac{f_1 - f_o}{2f_1 - f_o - f_2} \times h \tag{4.10.2.6}$$

$$= 35 + \frac{23 - 21}{2 \times 23 - 21 - 14} \times 10 \tag{4.10.2.7}$$

$$= 36.86 \tag{4.10.2.8}$$

codes for the above equation can be get from here

codes/static10.py