2) $\cancel{x^2+}$ x^2+y^2

x^2 + y^2

[1] 1300

3) $\cancel{sqrt}$ $\sqrt{x^2+y^2}$

sqrt(x^2 + y^2) → 1300

4) $\sqrt{y^3-x^2}$

sqrt $\sqrt{y^3 - x^3}$

137.8405

5) |x−y|

abs (x−y)

= 10

6) c(2,3,4,5)^2.

4 9 16 25.

7) c(4,5,6,8)^3

64 125 216 512

8) ~~−4~~ c(2,3,5,7) * c(−2,−3,−5,−4)

−4 −9 −25 −28

Basics of R Software.

1) R is a software for data analysis and statistical computing

2) This software is used for effective data handling and output storage is possible

3) It is capable of graphical display

4) It is a free software.

1) $2^2 + \sqrt{25} + 35$

→ 2^2 + sqrt(25) + 35

[1] 44.

2) $2 \times 5 \times 3 + 62 \div 5 + \sqrt{49}$

→ 2 * 5 * 3 + 62/5 + sqrt(49). → 49.4

3) sqrt(76 + 4*2 + 9/5) → $\sqrt{76 \times 4 \times 2 + 9 \div 5}$ → 9.26

4) $42 + |-10| + 7^2 + 3 \times 9$

→ 42 + abs(-10) + 7^2 + 3*9.

[1] 128.

5) x = 20

y = 30

x+y

[1] 50

Find the sum, prod, max, min, of the values

c= (5, 8, 6, 7, 9, 10, 15, 5)

$$\begin{bmatrix} 1 & 5 \\ 2 & 6 \\ 3 & 7 \\ 4 & 8 \end{bmatrix}$$

x <- matrix (nrow= 4, ncol=2,
data= c (1, 2, 3, 4, 5, 6, 7, 8))

$$x = \begin{bmatrix} 1 & 4 & 7 \\ 2 & 5 & 8 \\ 3 & 6 & 9 \end{bmatrix} \quad y = \begin{bmatrix} 2 & 4 & 10 \\ -2 & 8 & -11 \\ 10 & 6 & 12 \end{bmatrix}$$

x + y

x × y

2x + 3y

```
X= c(2,4, 6,1, 3,5,7, 18,16,14,17,17,3,
     3,2,5,0,13,9,4,18, 10,12).
a= table (x).
[1] 23.
a= table (x).
taransfoem (a).
```

AM

Can the following be p.d.f?

$$f(x) = \begin{cases} 2-x & ; 1 \le x \le 2. \\ 0 & \text{o.w.} \end{cases}$$

To prove:- $f(x)\,dx = 1$

$\int_1^2 (2-x)\,dx.$

$\int_1^2 2dx - \int_1^2 x dx.$

$= 2x \Big|_1^2 - \frac{x^2}{2}\Big|_1^2$

$= (4-2) - (2-0.5)$

$= 2 - 1.5$

$= 0.5$

Hence it is not a p.d.f.

$$f(x) = \begin{cases} 3x^2 & ; 0 < x < 1. \\ & \text{o.w.} \end{cases}$$

To prove :- $f(x)\,dx = 1.$

$\int_0^1 3x^2.$

$= \frac{\cancel{3}x^3}{\cancel{3}}\Big|_0^1$

$= 1 - 0.$

Hence it is a p.d.f.

3) $f(x) = \begin{cases} \frac{3x}{2}\left(1-\frac{x}{2}\right); & 0 \le x \le 2. \\ 0 & \text{o.w.} \end{cases}$

$\rightarrow \int_0^2 \frac{3x}{2}\left(1-\frac{x}{2}\right)$

$= \left[\frac{3x^2}{4}\left(x-\frac{x^2}{4}\right)\right]_0^2$

$= \frac{12}{4} - 2 - 0.$

$= 3-2$

$= 1$

Q2) Can the following be p.M.F

(i)

x	1	2	3	4	5
p(x)	0.2 0.3		−0.1	0.5	0.1

$\sum p(x) = 1.$
Hence it is a p.M.F.

(ii)

x	0	1	2	3	4	5
p(x)	0.1	0.3	0.2	0.2	0.1	0.1

Q3) $P(x \le 2)$, $P(2 \le x \le 4)$, $P(\text{atleast } 4)$, $(P\ 3 < x < 6)$

x	0	1	2	3	4	5	6
p(x)	0.1	0.1	0.2	0.2	0.1	0.2	0.1

i) $P(x \le 2)$.

$P(0) + P(1) = 0.1 + 0.1 = 0.2.$

ii) $P(2 \le x < 4)$.

$P(2) + P(3) + P(4)$.

$= 0.2 + 0.2 + 0.1$

$= 0.5$.

iii) $P(4) + P(5)$

$= 0.1 + 0.2$

$= 0.3$

iv) $P(4) + P(5)$

$= 0.1 + 0.2$

$= 0.3$.

~~Q4) Prob~~ = (~~(0.1, 0.1)~~, 0.2, ~~0.2~~ 0.2, ~~0.1~~, ~~0.2, 0.1~~).

1)

x	0	1	2	3	4	5	6
$P(x)$	0.1	0.1	0.2	0.2	0.1	0.2	0.1

2)

x	10	12	14	16	18
	0.2	0.35	0.15	0.2	0.1

Ans 1) $F(x) = 0$ if $x < 0$.

$= 0.1$ if $x \le x < 1$

$= 0.2$ if $1 \le x < 2$

$= 0.4$ if $2 \le x < 3$

$= 0.6$ if $3 \le x < 4$

$= 0.7$ if $4 \le x < 5$

$= 0.9$ if $5 \le x < 6$

$= 1.0$ if $x \ge 6$

A4

Ans 2) $F(x) = 0$. if $x < 0$.

$= 0.26$ if $x \le 10 \le 12$

$= 0.55$ if $x \le 12 < 14$

$= 0.70$ if $x \le 14 < 16$

$= 0.90$ if $x \le 16 < 18$

$= 1.00$ if $x \ge 18$

Practical-3.

Probability distribution and B.D

1) Find PDF of the foll CDF and draw the graph.

x	10	20	30	40	50.
$f(x)$	0.15	0.25	0.3	0.2	0.1

→ $P(x) = 0$. if $x < 10$
$= 0.15$ $10 \le x < 20$
$= 0.40$ $20 \le x < 20$
$= 0.70$ $30 \le x < 30$
$= 0.90$ $40 \le x < 40$
$= 1.0$ $x \ge 50$.

```
> x= ((10, 20, 30, 40, 5)
prob= (l0.15, 0.25, 0.3, 0.2, 0.1)
cumsum (prob)

[1] 0.15 0.40 0.70 0.90 1.0

> plot (x, cumsum(prob), xlab= ("values"), ylab=
"probability"), main= "graph of cdf" ("s"))
```

Binomial distribution

2) Suppose there are 12 mcq's in a test each question has 3 option and only one of them is correct. Find the probability of having in 5 correct answer (2) at most 4 correct answers

→ $n = 12$, $p = 1/5$, $q = 4/5$

x = total no. of correct ans

$X \sim B(n, p)$

$n = 12$, $p = 1/5$, $q = 4/5$, $x = 5$

$n = 12$; $p = 1/5$; $q = 4/5$; $x = 5$

sum (n, p, q, x)

[1] 18

> dbinom (5, 2, 1/5)

0.0531022

> pbinom (4, 12, 1/5)

[1] 0.9274445

3) There are 10 members in a committee, the probability of any no. attending a meeting is 0.9. Find the probability

(i) 7 member attended

(ii) Atleast 3 members attended

(iii) Atmost 6 members attended

→ Given that

$n = 10$, $p = 0.9$ $q = 0.1$

X = Total no. of member attached.

$X \sim B(n, p)$

$n = 10$, $p = 0.9$, $q = 0.1$

```
> n = 10; p = 0.9; q = 0.1
> dbinom(7, 10, 0.9)
[1] 0.05739

> 1 - pbinom(5, 10, 0.9)
[1] 0.99836

> pbinom(6, 10, 0.9)
[1] 0.012 7952
```

4) Find the c.d.f and draw the graph

x	0	1	2	3	4	5	6
p(x)	0.1	0.1	0.2	0.2	0.1	0.2	0.1

→ (x)= c(1,2,3,4,5,6)

```
>prob=c(0.1,0.1,0.2,0.2,0.1,0.2,0.1)
> cumsum(prob)
[1] 0.1 0.2 0.4 0.6 0.7 0.9 1.0.
```

```
> plot(x, cumsum(prob), xlab="values",
ylab="probability", main="graph of c.d.f",
"s")
```

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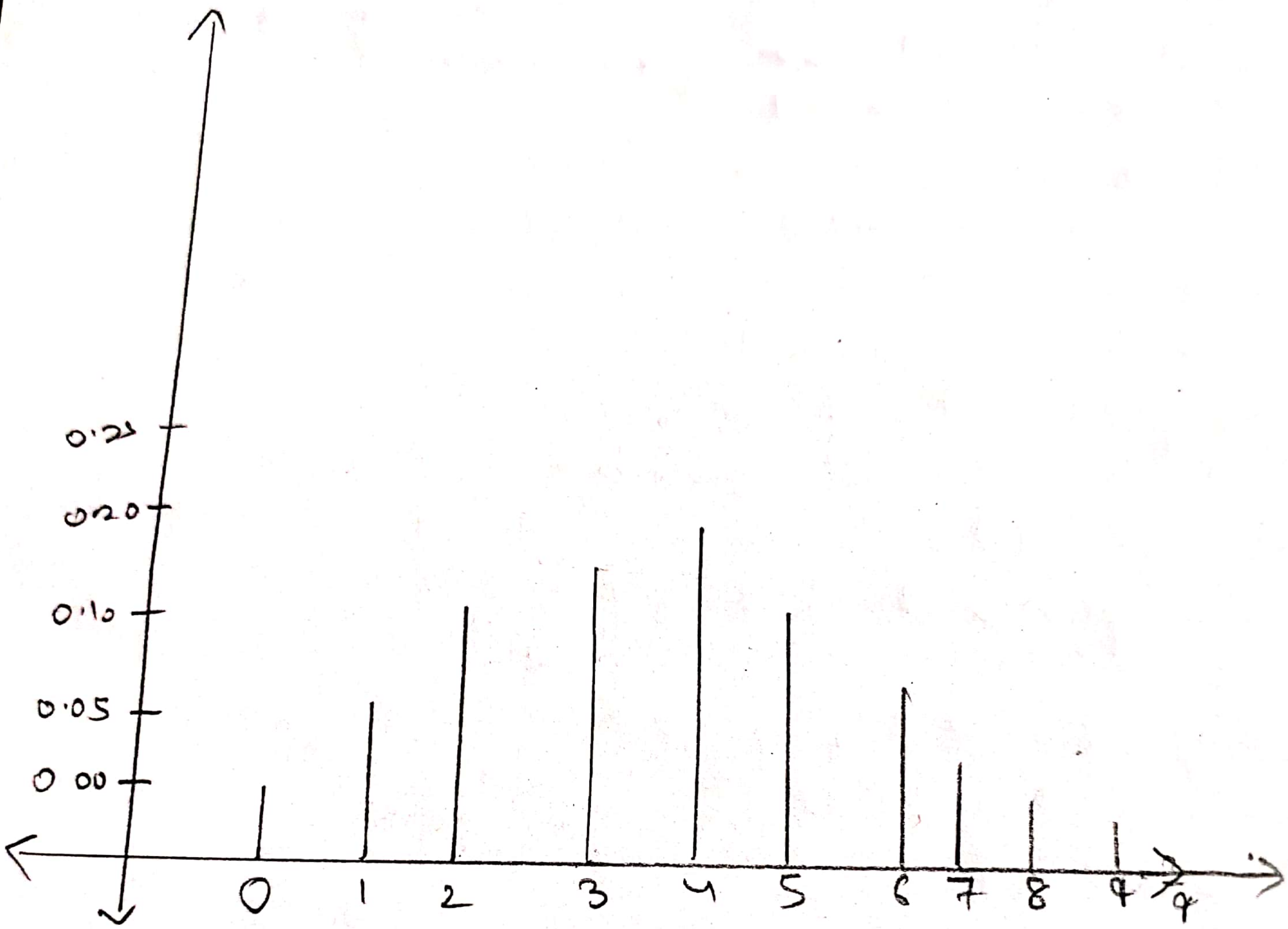


0.25
0.20
0.10
0.05
0.00
0
1
2
3
4
5
6
7
8
9
q

Practical - 4.

Binomial distribution.

1) Find the complete B.D where $n=5$ and $p=0.1$.

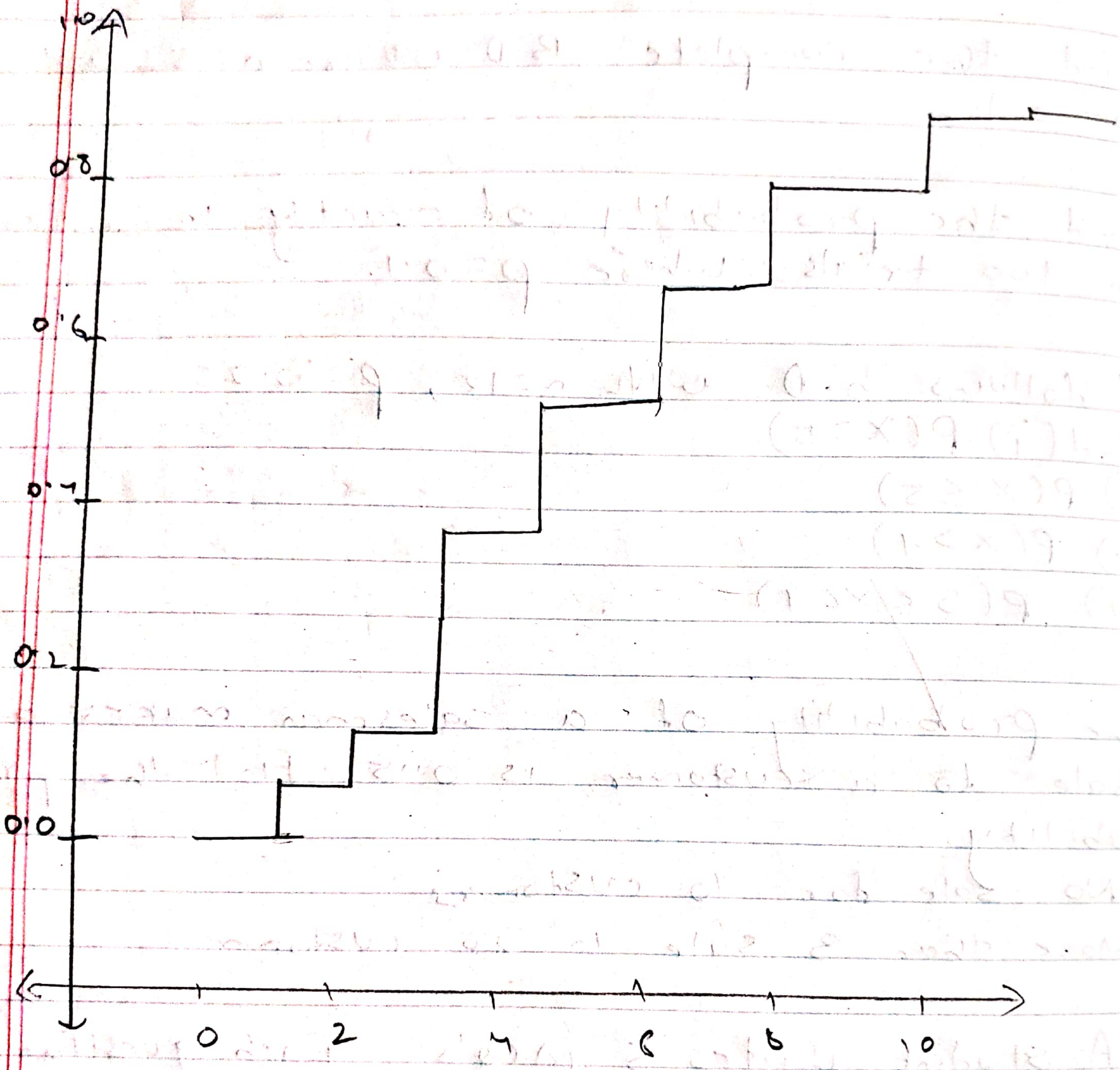
2) Find the probability of exactly 10 success in 100 trials where $p=0.1$.

3) X follows b.D with $n=12$, $p=0.25$
Find (i) $P(X=5)$
(ii) $P(X \leq 5)$
(iii) $P(X>7)$
(iv) $P(5<X<7)$

4) The probability of a salesman makes a sale to a customer is 0.15. Find the probability.
(i) No sale for 10 customers.
(ii) More than 3 sale in 20 customer.

5) A student writes 5 MCQ's. Each question has 4 options out of which one is correct. Calculate the probability for atleast 3 correct answers.

6) X follows B.D $n=10$, $P=0.4$. Plot the graph of P.M.F and C.D.F.



Q. 10

$p(X=x) =$ dbinom(x, n, p)
$p(X \le x) =$ pbinom(x, n, p).
$p(X > x) =$ pbinom(x, n, p).

To find the value of x for which the prob is given as p, the command is
qbinom (p, n, p).

1) n=5, p=0.1.
dbinom (0:5, 5, 0.1).
→ 0.59049 0.32805 0.07290 0.00810 0.00045 0.00001

2) n=100, p=0.1 x=10.
dbinom (10, 100, 0.1)
→ 0.1318653.

3) n=12, p=0.25, x=5.
i) dbinom (5, 12, 0.1).
→ 0.1032414.
ii) $P(x \le 5)$.
dbinom (0:5, 12, 0.1)
iii) $P(X > 7)$
1-pbinom (7, 12, 0.25)

4) n=10, p=0.15, x=0.
i) pbinom (0, 10, 0.15).
→ 0.1968744.
ii) n=20, p=0.15 (x > 3)
1-pbinom $(x \le 3)$ = 1- p(binom (3, 20, 0.15)
→ 0.3522748.

5) $P(X \geq 3)$
$= 1 - P(X \leq 2)$
$= 1 - \text{pbinom}(2, 5, 1/4)$.
$= 0.1035156$.

6) n=10, p=0.4.
x= 0:n.
prob= dbinom (x,n,p).
cumprob= pbinom(x,n,p).
d= data.frame ("x values"= x, "probability"=pr
print(d).
plot (x, prob, "h").
plot (x, cumprob, "s").

→ x. values probability.

1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7
9	8
10	9
11	10

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Practical - 5

1) $P[X = x] =$ dnorm (x, μ, σ)
2) $P[X \leq x] =$ pnorm (x, μ, σ)
3) $P(X > x) =$ 1 - pnorm (x, μ, σ)
4) $P(x_1 < x < x_2) =$ pnorm (x_2, μ, σ)
5) $P(X \leq k) = P_1$; qnorm $(P_1, \mu, \sigma$
6) rnorm (n, μ, σ)

To find value of k so that
$P(x \leq k) = P_1$; qnorm (p_1, μ, σ)

1 $X \sim N(\mu = 50, \sigma^2 = 100)$
i) $P(x \leq 40)$
ii) $P(x > 55)$
iii) $P(42 \leq x \leq 60)$
iv) $P(x \leq k \leq 60)$

Generic 10 random nos from a normal distrib with mean(M) 60, S.D = 5. Also calculate the Sample mean, median, variance and

Draw the graph of Standard normal distributi

3) 60.76603 60.02792 57.47460 52.13985
62.58680 63.70532 60.48190 58.03537

mean (x) = 59.50707
v = (n-1) * var (x)/n
v = 9.301891
sd = sqrt(v)
= 3.0499

i) a = pnorm (40,50,10)
cat ("p (x ≤ 40) is =", a)

0.1586553
p(x < 40) is 0.158655

ii) > b = 1-pnorm (55, 50, 10)
cat ("p(x > 55) is = ", b)
p (x > 55) is 0.0308 537 55

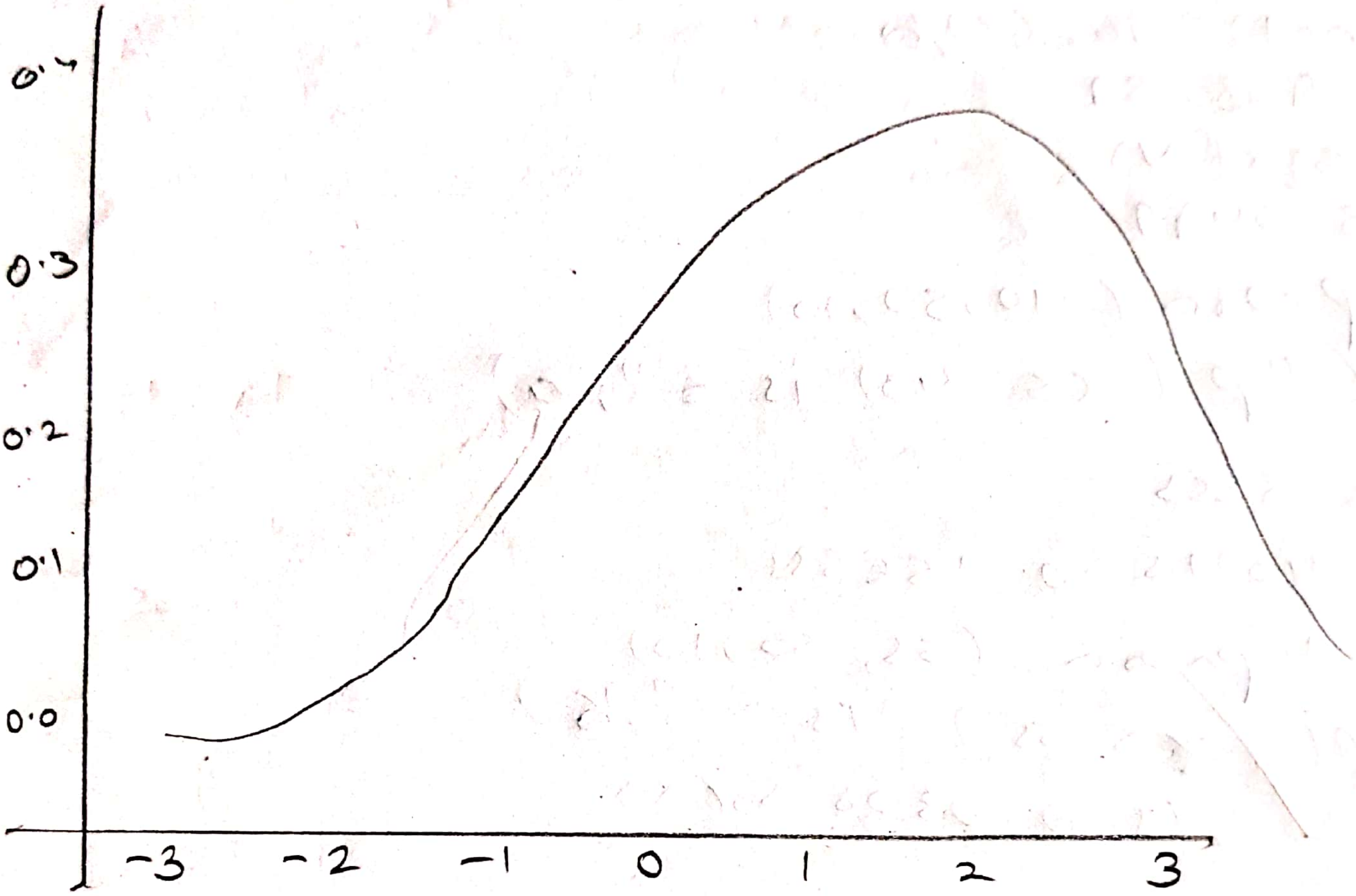
0.3085375

iii) c = pnorm (60, 50, 10) - pnorm (42, 50, 10)

0.6294893

2) a = pnorm (110, 100, 6)
0.9522096

b = pnorm (95, 100, 6)



0.4
0.3
0.2
0.1
0.0
-3
-2
-1
0
1
2
3

(4) x = seq(-3, 3, by=0.1)
> x

~~y= dnorm(x)~~

y= dnorm(x)
>plot(x, y, xlab="xvalues", ylab="prob", main="standard normal graph")

Practical - 6.

Test the hypothesis (H_0) $H_0: \mu = 10$ against $H_1: \mu \neq 10$. A sample of size 400 is selected which gives the mean 10.2 and standard deviation 2.25. Test the hypothesis at 5% level of significance.

$H_0: \mu = 10$ against $H_1: \mu \neq 10$.
10.2 2.25 5%.

mo = 10; mx = 10.2, sd = 2.25; n = 400.
zcal = (mx - mo) / (sd / (sqrt(n))) = 1.777
cat ("z cal is = ", zcal)
pvalue = 2 * (1 - pnorm(abs(zcal)))
pvalue = 0.0754

Test the hypothesis $H_0 = 75$ against $H_1: \mu \neq 75$.
A sample of size 100 is selected and the sample mean is 80 with a S.D of 3. Test the hypothesis at 5% level of significance.
$H_1: \mu = 75$ against $H_1: \mu \neq 75$.
mo = ~~80~~ 75 mx = 80.
sd = 2.25
n = 400

Test the hypothesis known $\mu = 25$ against $h_1\ \mu \neq 25$ at 5% level of significance. Full sample of 30 is selected

4) x = 20, 24, 27, 35, 30, 46, 26, 27, 10, 20, 30, 37, 35, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 27, 15, 19, 22, 20, 18.

mean (x).
n = length(x).
variance = (n-1) * var(x)/n.
variance.
5 ~~3~~.2622.
sd = sqrt (variance)
7.0895

5) Experience has proved that 20% students of a college smokes out of a sample of 400 students reveal that out of 400 only 50 smoke. Test the hypothesis that the experience gives the correct proportion or not.

Test the hypothesis $H_0: P = 0.5$ against $H_1: P \neq 0.5$
A sample of 200 is selected and the sample proportion is calculated. Test the hypothesis at 1% significance.

$P = 0.5$

$p = 0.56$

$Q = 1 - P$.

$z\,cal = (p - P) / (sqrt(P * Q / n))$

$= 2.4$.

Pvalue = 2 * (1 - pnorm (abs (zcal))).

pvalue = 0.0163

Practical-7
Large sample tests

A study of noise level in 2 hospital is calculated below the test hypothesis that the noise level into hospitals are same or not

	Hos. A	Hos B.
No. of sample obs.	84	34
mean	61	59
S.D	7	8

Ho: The noise levels are same

n1 = 84
n2 = 34
mx = 61
my = 59
sdx = 7
sdy = 8
z = (mx-my) / sqrt((sdx^2/n1)+(sdy^2/n2))
cat("z calculated is = ",z)
pvalue = 2*(1-pnorm(abs(z)))

Since value < 0.05 , we reject Ho at 5% level of significance

z = 1.273

pvalue = 0.1291361

2

2) 2 random samples of size 1000 and 2000 are drawn from 2 population with mean of 67.5 and 68 respectively and with the same S.D of 2.5. Test the hypothesis that the mean of 2 populations are equal.

Ho. is the same.

	A	B
~~No. of obs~~	~~34~~	~~34~~
~~mean~~	~~61~~	~~59~~
~~S.D~~	~~7~~	~~8~~

	A	B
no. of obs	1000	2000
mean	67.5	68
S.D.	2.5	2.5

n1 = 1000

n2 = 2000

mx = 67.5

my = 68

sdx = 2.5

sdy = 2.5

z = (mx-my)/sqrt((sdx^2/n1)+(sdy^2/n2))

= -5.163

pvalue = 2*(1-pnorm(abs(z)))

= 2.41764e-07

3) In FYBSC 20% of a random sample of 400 students had defective eyesight, the SYBSC class had 15.5% of 500 sample had the same defect, is the difference of proportion is same?

→ Ho the proportion of the population are equal

$n1 = 400$

$n2 = 500$

$p_1 = 0.2$

$p_2 = 0.55$

$p = (n1 * p_1 + n2 * p2) / (n1 + n2)$

$= 0.175$

$q = 1 - p$

$= 0.825$

$z = (p_1 - p_2) / sqrt(p * q * (1/n_1 + 1/n_2))$

$z = 1.76547$

cat ("z calculated is", z)

pvalue = 2 * (1 - pnorm(abs(z)))

= 0.07748

6

From each of the box of the apples a sample size of 200 is collected. It is found that there are 44 bad apples in the first sample and 30 bad, 2nd sample. The 2 boxes are equivalent in terms of no. of bad apples.

Ho is that 2 boxes are equivalent

$n1 = 200$

$n2 = 200$

$p1 = 44/200$

$p2 = 30/200$

$p = (n1 * p1 + n2 * p2) / (n1 + n2)$

$q = 1 - p$.

$p = 0.185$.

$q = 0.815$.

$z = (p1 - p2) / sqrt (p * q * (1/n1 + 1/n2))$

$z = 2.549461$

pvalue = 2 * (1 - pnorm (abs (z)))

= 0.0107

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5) In MA class out of the sample of 60 mean height is 63.5 ~~each~~ inch, with a S.D of 2.5. In an M.Com ~~[illegible]~~ of 50 students. Mean height of 69.5 inches with a S.D of 2.5, test the hypothesis that the mean of MA and M.Com class are same.

The mean height of MA. and M.Com are equal
~~Ho is the [illegible] classes are equivalent.~~

$n1 = 60.$

$n2 = 50.$

$p1 = 0.041$

$p2 = 0.05$

$p = (n1 * p1 + n2 * p2)/(n1+n2)$

$= 0.04509.$

$q = 1-p.$

$= 0.954$

$z = (p_1 - p_2) / sqrt(p * q * (1/n_1 + 1/n_2))$

$z = -0.22650$

Practical- 8.
Small sample test.

The tens are selected and height are found be 63, 63, 68, 69, 71, 71, 72 cms. Test hypothesis that mean height are 66 cms or not at 1.

Ho = Mean = 66 cms.

> mean = 66
> x = c (63, 63, 68, 69, 71, 71, 72)
t. test (x)

One sample test t-test.
data: x.
t = 47.94, df = 6, Pvalue = 522 e - 09
alternative hypothesis mean is not equal too
95 percent confidence interval
64.66479 71.62092

Sample estimates
mean of x
68.14286
pvalue < 0.01 is rejected on in 1% level of significance.

2. Two random Sample was drawn from 2 different population
Sample 1 = 8, 10, 12, 11, 16, 15, 8, 7
sample 2 = 20, 15, 18, 9, 8, 10, 11, 12.
let the hypothesis that there is no difference between the hypothesis that there is no difference the 2 mean at 5%. level of significance

H_0 there is no difference in the population mean
x = c (8, 10, 12, 11, 16, 15, 18, 7)
y = c (20, 15, 18, 9, 8, 10, 11, 12)
t.test (x, y)
Watch 2 Sample t.test
data: x and y.
t = -0.36247, df = 13.837 p-value = 0.7225
alternative hypothesis: true difference in mean is not equal −5.692719 3.692719
Sample estimates
mean of x mean of y
12.125 12.875
p value < 0.01 is accepted in H_0. On 1%. level of significance

18

3) Following are the weight of 10 people.

Before = (100, 125, 95, 96, 98, 102, 118, 104, 109, 110)
After = (95, 80, 95, 98, 90, 100, 110, 85, 100, 101)
Ho: The diet program is not affective.

x = c(100, 125, 95, 96, 98, 102, 115, 104, 109, 110)
y = c(95, 80, 95, 98, 90, 100, 110, 85, 100, 101)
t.test(x, y, paired = T, alternative = "less")

Paired t-test
data x and y.
t = 2.3215, df = 9, p-value = 0.9773
alternative hypothesis :- true difference in means is less than 0.95 percent confidence interval.
-Inf 17.89635
Sample estimates
mean of the differences
10.
pvalue < 0.01 is accepted in Ho on 1% level of significance.

AM
4.3.20

4) Marks before and after a training program is given below

before = 20, 25, 32, 28, 27, 36, 35, 25

after = 30, 35, 32, 37, 37, 40, 40, 23

Test the hypothesis that training program is effective or not.

Ho- The training program is not effective

x=c(20, 25, 32, 28, 27, 36, 35, 25)

y=c(30, 35, 32, 37, 37, 40, 40, 23)

t:test (x, y, paired=T, alternative= "greater")

paired t test.

data x and y.

t= -3.858, df=7, p-value= 0.9942

alternative hypothesis true difference it means is greater than 0.95 percent confidence interval

-8.967399 inf.

Sample estimates

mean of the difference

-5.75

pvalue <0.01 is accepted in Ho and 1% 10%.

5) 2 random sample were drawn from 2 normals population and the value are

A= 66, 67, 75, 76, 82, 84, 88, 90, 92

B= 64, 66, 74, 78, 82, 85, 87, 92, 93, 95, 97

Test whether the population have same variance at 5% level of significance

Ho variance of the population are equal

x = c(66, 67, 73, 76, 82, 84, 88, 90, 92)
y = c(64, 66, 74, 78, 82, 85, 87, 92, 93, 95, 97)
var.test(x, y)

Test to compare 2 variances.
data x and y.
F = 0.70686, num df = 8, denom df = 10
p-value = 0.6359 95% confidence interval
0.1833662 3.0360393
Sample estimates
ratio of variance
0.7088567

6. Ho: population mean = 55
n = 100
mx = 52
mo = 55
sd = 7
zcal = (mx - mo) / [sd / sqrt(n))
pvalue = 2 *(1 - pnorm(abs(zcal)))
pvalue
= 1.8213e-05

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Practical 9

Chi square.

Q) Use the foll data to test whether the cleanliness of the home depends upon the child or not:

Condition of home

	Clean	Dirty
clean	70	50
fairly clean	80	20
dirty	35	45

x = c(70, 80, 35, 50, 20, 45)

m = 3

n = 2

y = matrix(x, nrow=m, ncol=n)

y

c = chisq.test(y)

Since pvalue is less than 0.05 we ~~accept~~ reject ho at 5% level of significance

X-squared = 25.646, df = 2, p-value = 2.698.

a

Table below shows the relation between performance of maths and computer of CS students

		Maths		
		HG	MG	LG
	HG	56	71	12
comp.	MG	47	163	38
	LG	14	42	85

H_0 : Performance between maths and computer are independent

m= 3
n= 3
y= matrix (x, nrow=m, ncol=n)
y
pv= chisq. test (y)

x - squared= 145.78, df=4, p-value < 2.2e-1

3) Perform ANOVA for the following data

Varities	Observations
A	50, 52
B	53, 55, 53
C	60, 58, 57, 51
D	52, 54, 54, 55

Ho The means of varity ABCD are equal

x1 = c(50, 52)
x2 = c(53, 55, 53)
x3 = c(60, 58, 57, 51)
x4 = c (52, 54, 54, 55)

d= Stack (list (b1= x1, b2 = x2, b3 = x3, b4= x4))
names (d)

Oneway test (values= indep, data= d, var.equal =T)
One-way analysis of means

data: values and ind
F= 11.735, num df= 3, denom df= 1, p-value= 0.0013
anova = aov (values ~ ind, data = d)
anova:
Call :
aov (formula= values ~ ind, data =d)
Terms:
ind Residuals

Sum of squares 71.06410 18.16667
Deg. of Freedom 3 9

Residual standard error: 1.420746
Estimated effects may be unbalanced

> summary (anova)

	Df	Sum sq	mean	F value	Pr(>F)
Ind	3	71.06	23.6	11.73	0.00183 **
Residuals	9	18.17	2.019		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

4) Perform anova on the foll table.

Types	observations
A	6, 7, 8
B	4, 6, 5
C	8, 6, 10
D	6, 9, 9

```
a = c(6,7,8)
b = c(4,6,5)
c = c(8,6,10)
d = c(6,9,9)
d = stack (list (b1=a, b2=b, b3=c, b4=d))
names (d)
```

oneway.test(values~ind, data=d, var-equal=T)

One-way analysis of means

data: values and ind
F= 2.6667, num d.f = 3, denom df = 8, p-value = 0.1187

anova = aov (values~ind, data=d)

anova

Call:
aov (formula = values~ind, data=d)

anova

Call:
aov (formula= values~ values~ ind, data=d)

Terms:

	ind	Residuals
Sum of squares	18	18
Deg of freedom	3	8

Residual standard error : 1.5
Estimated effects may be unbalanced

> summary (anova)

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
ind	3	18	6.00	2.667	0.119
Residuals	8	18	2.25		

Practical - 10

Aim:- Non parametric test.

Following are the amounts of sulphur oxide emmited by a factory.
70, 50, 20, 29, 19, 18, 22, 25, 27, 9, 24, 20, 17, 6, 24, 14, 15, 23, 24, 26.
Apply sign test to test the hypothesis that the population median is 21.5. Against the alternative it is less than 21.5.

H_0 Population median = 21.5
H_1 It is less than 21.5

```
x=c(15,17,20,29,19,18,22,25,27,9,24,20,17,6,
    24,14,15,23,24,26)
m=21.5
sp= length(x[x>m])
Sn= length(x[x<m])
n= sp+ sn
n
[1]20
pv= pbinom(sp,n,0.5)
pv
[1] 0.4119015
```

If the alternative is greater than median
pv= pbinom(sn, n, 0.5)

For the observation 12, 19, 31, 28, 43, 40, 55, 49, 70, 63. Apply sign test to test population median is 25 against the alternative is more than 25.

```
x=c(12,19,31,28,43,40,55,49,70,63)
m=25
sp=length(x[x>m])
sn=length(x[x<m])
n=sp+sn
n=10.
pv=pbinom(sn,n,0.5)
pv
[1] 0.0546875
```

For the foll data, 60, 65, 63, 89, 61, 71, 58, 51, 48, 66, Test the hypothesis using Wilcoxon Sign rank test. For testing the hypothesis that the median is 60 against the alternative it is greater than 60.

Ho is 60
H1 is greater than 60.

```
x=c(60,65,63,89,61,71,58,51,48,66)
wilcox.test(x,alter="greater",mu=60)
V=28.
P-value = 0.2386
```

If the alternative is less ^ wilcox.test(x, alter="less",mu=__).

If the alternative is not equal to

wilcox.test(x, "2.sided") mu

Q4) Using Wilcox. test, test the hypothesis, the median is 12 against the alternative less than 12

12, 13, 10, 20, 15, 5, 1, 7, 6, 11, 9, 20

V = 25

p-value = 0.2521

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