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1. R program to print "Hello World!" on the screen.

```
print ("Hello World!")
```

Output :- "Hello World!")

2. R program for variable declarations.

```
a<-5
cat(a)
```

Output :- 5

3. R codes for mathematical operators :-

(i)
```
a<-5
b<-6
a+b
```

Output :-

11

(ii)
```
a<-c(1,2,-3,5,6)
b<-c(0,1,3,6,7)
a+b
a-b
a*b
```

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Output :-

```
a+b
[1] 1 3 0 11 13
a-b
[1] 1 1 -6 -1 -1
a*b
[1] 0 2 -9 30 42
```

(iii)

```
a<- -10
b<- 7
c<- 15
(a+b)*c -10*a+b
(a+b)/c +c/a+b
-15*c +a*b -c/a
```

Output :-

```
(a+b)*c -10*a+b
[1] 62
(a+b)/c +c/a+b
[1] 5.3
-15*c +a*b-c/a
[1] -293.5
```

(iv)

```
a<-c(1,2,3,5)
b<-c(10,11,12,20)
c<-c(20,10,-5)
length(a)
length(b)
```

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```
length(c)
a+b+c
Output :-
length(a)
[1] 4
length(b)
[1] 4
length(c)
[1] 3
a+b+c
[1] 31 23 10 45
```

(v)
```
a<-c(1,2,3,5)
b<-c(10,11,12,20)
c<-c(10,10,-5,-2)
a+b+c
(a*b)*(c+a)-(15/(a*b))
Output :-
a+b+c
[1] 21 23 10 23
(a*b)*(c+a)-(15/(a*b))
[1] 108.50000 263.31818 -72.41667 299.85000
```

(vi)
```
a<--10
b<-10
c<--5
(a+b)^2/(b^a)+c^(2*a)/(b^(2+c))-10
Output:-
[1] -10
```

(vii)
```
x<-15
y<-20
z<--5
x^y+log(x)+factorial(y)-
    exp(x)-y*z^2
Output :-
[1] 3.325281e+23
```

(viii)
```
x<-c(1,2,3,4,5,6,7,8)
sum(x)
Output :-
sum(x)
[1] 36
```

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4. R codes for different operators.

(i)
```
a<-c(1,2,-3,5,6)
c(1,2,-3,5,6) == a
```
Output :-
[1] TRUE TRUE TRUE TRUE TRUE

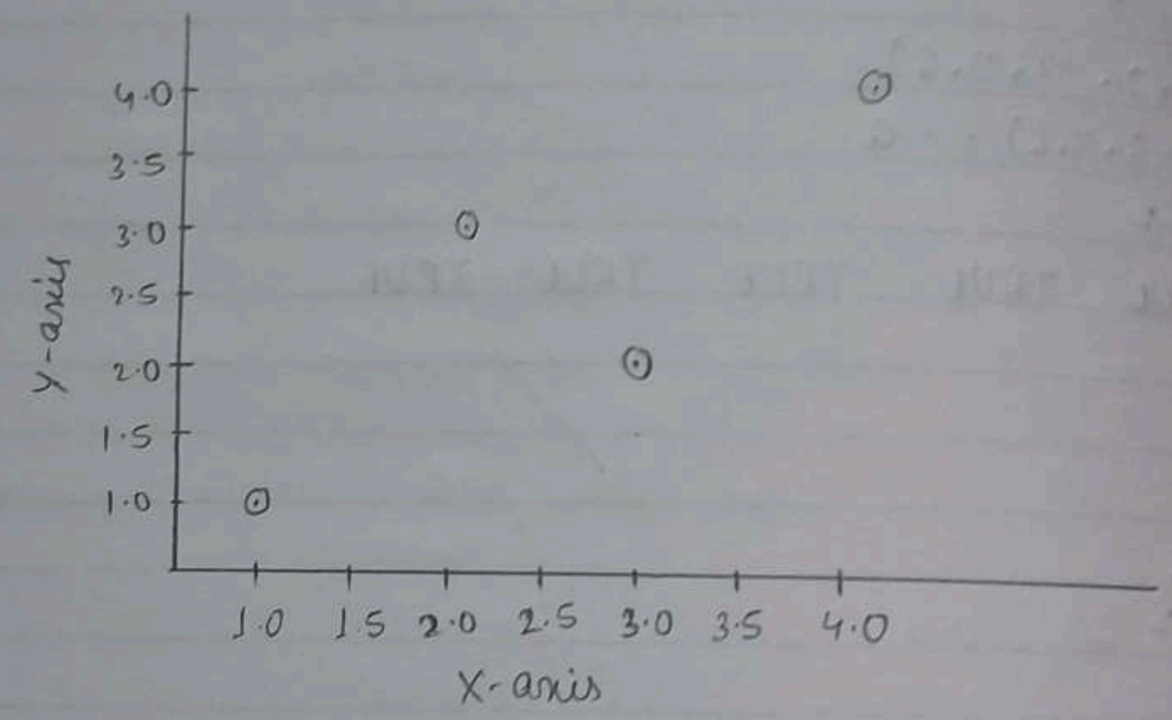
(ii)
```
a<-5
b<-6
a %/% b
```
Output :-
[1] 5

(iii)
```
a<-c(1,2,3,5)
b<-c(10,11,12,20)
a %% b
```
Output :-
[1] 1 2 3 5

(iv)
```
x<-c(1,2,3,4,5)
y<-c(-10,10,5,6)
x & y
```
Output :-
[1] TRUE TRUE TRUE TRUE TRUE

(v)
```
rep(5, times=10)
```
Output :-
[1] 5 5 5 5 5 5 5 5 5 5

Teacher's Signature:



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5. R codes for graphs :-

(i) x <- c (1, 3, 2, 4)
plot(x, xlab = "x-axis", ylab = "y-axis")

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Assignment NO. 01

1. What is the difference between R and C programming languages ?

⇒

R language	C language
(i) High-level, interpreted language.	(i) Low-level, compiled language
(ii) Primarily used for statistical computing and data analysis.	(ii) Used for system programming and embedded systems.
(iii) Supports vectorised operations and plotting	(iii) No built-in support for plotting or statistical analysis.
(iv) Has built-in data structures like vectors, data frames, matrices.	(iv) Uses arrays, structs, and manual memory management.
(v) Memory managment is automatic. (mostly).	(v) Manual memory allocation and deallocation.

2. Write down three real-life situations where R programming language is used.

⇒ 1) Healthcare & Epidemiology

- Analyzing patient data, predicting disease outbreaks, visualising spread (e.g., COVID-19 data analysis).

2) Finance & Banking

- Portfolio risk analysis, fraud detection, financial forecasting using time-series models.

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3) Marketing Analytics
- Customer segmentation, behaviour prediction, and analyzing sales trends.

5. What is the difference between NA and NAN in R programming?

⇒

	NA (Not Available)	NAN (Not a Number)
(i)	Represents missing or undefined data.	Represents invalid or undefined numeric results.
(ii)	Used when a value is not recorded or missing in data.	Used when a value results from an undefined mathematical operation.
(iii)	Can be of different types: logical, integer, character, etc.	Always a numeric value (double).

Example 1 :-
```
x <- c(1, 2, NA, 4)
is.na(x)
# [1] false false True false
```

Example 2 :-
```
y <- 0/0
print(y)      #NAN
is.nan(y)     #TRUE
is.na(y)      #TRUE
```

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4. What is the major difference between R and Rstudio?

⇒

	R	Rstudio
(i)	A programming language and statistical computing engine.	An Integrated Development Environment (IDE) to work with R more easily.
(ii)	Executes code, performs analysis, and handles data.	Provides tools (script editor, console, plot viewer, etc) to write, organise and visualise R code.
(iii)	Can work independently through a basic console.	Depends on R to run, it cannot function without R installed.

5. How to create a vector using c() and seq()?

⇒
```
# Using c()
vec1 <- c(1,2,3,4)

# Using seq()
vec2 <- seq(1,10, by=2)
```

6. Write all numbers between 0 and 15 within a range of 0.5 in R code?

⇒ seq(0,15, by=5)

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Output :-
[1] 0 5 10 15

7. How do you assign a variable in R?

```
x <- 10
y <- 20
```

8. Calculate of sine, cosine, exponential and logarithm values of 28, 33, 12 and 19.

```
nums <- c(28, 33, 12, 19)
sin(nums)
cos(nums)
exp(nums)
log(nums)
```

9. Examine that the relation is true or false in R code?

(a) 10 > 2 , (b) 2 < 3 , (c) 3 + 4 = 8 and (d) 87 = 1.
True True False False

10. Write a code to calculate the absolute values of -4.2 and 0.3 in R.

```
abs(-4.2)
abs(0.3)
```

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11. Write short description in "Help in R"?

⇒ You can access help of any function using :-

```
? mean
help("mean");
```

- Use help.start() to launch help system in web browser.

12. Write short description of operators in R?

⇒ R includes :-
- Arithmetic operator :- +, -, *, /, ^, %/%
- Relational operator :- <, >, <=, >=, ==, !=
- Logical operator :- &, !, |, &&, ||

13. What is the difference between arithmetic & logical operator?

⇒ Arithmetic Performs math Ex → 5+3 O/P : 8
Logical performs comparisions 5>3 & 2<4 True

14. What is the difference between assignment and relational operator?

⇒ Assignment assigns value x<-5 assigns 5 to x
Relational compares value x==5 checks if x is 5

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15. State True or False:

(i) Factorial value of 38 is fact(38). → FALSE

(ii) Factorial value of 9 is factor(38). → FALSE

(iii) The factorial value of 5.8 is factorial(5.8). → TRUE

(iv) The absolute value of -8 is absol(-8). → FALSE

(v) The absolute value of -7.7 is abs(-7.7). → FALSE

(vi) The absolute value of -32 is absolute(-32). → FALSE

(vii) The summation of 1,4 and 8 is summa(1,4,8). → FALSE

(viii) The summation of 1,4 and 8 is summation(1,4,8) → FALSE

(ix) The summation of 1,4, and 8 is sum(1,4,8) → TRUE

(x) The next integer value is 4.4 is floor(4.4). → FALSE

(xi) The next integer value of 4.4 is celling(4.4). → TRUE

(xii) The logarithm value of 49 based on 2 is log(49,2) → FALSE

(xiii) The logarithm values of 49 based on 2 is log(2,49) → FALSE

16. What is difference between log() and ~~ton~~ ln() functions in R, for the purpose of logarithm value?

=>	log()	ln()
(i)	Calculating logarithm, including natural log by default.	Does not exist by default in R.
(ii)	Default base: e	If you use you will get error.

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17. Difference between seq() and colon operator in R?

⇒	seq()	colon(:)
(i)	less flexible	(i) more flexible
(ii)	return simple integer range.	(ii) Can return custom sequences.
(iii)	step size is fixed at 1 or -1.	(iii) Step size is customisable with by or length.out.

18. Let, the value of variable a be 2, 5, 8, 1, 21, 7, 4, 23, 15.

(a) To extract the value 21 and together this number 5, 4, 15.

⇒ a<-c(2 5, 8, 1, 21, 7, 4, 23, 15)

a[c(5, 2, 7, 9)]

O/P :- 21, 5, 4, 15

(b) Dropout 5th position no. and also, together with number 1, 4, 15?

⇒ a_minus_5<-a[-5]

a[c(4, 7, 9)]

Output:-

[1] "2" "3" "5"

20. Is it possible to inspect source code of R ? (a) Yes

21. Scripts will run on (a) Script Editor

22. On which IDE we can interact with R ? (b) Rstudio

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Q3. R is mostly used in (d) All of mentioned

24. What is meaning of <- ? (d) Assignment

25. Data frames can be converted into a matrix by calling the following function data (b) matrix()

26. What will be the output of the following R code:
x <- ("a", "b")
as. logical (x)
(d) Error

27. What will the output of following R code?
x <- c(3, 7, NA, 4, 7)
y <- c(5, NA, 1, 2, 2)
Then x+y
(b) Missing data

28. What is the length of a?
a <- 2:19
(b) 18

29. What is the function to set row names for a data frame?
(a) rownames()

30. Which of the following is used for statistical analysis in R language?
(a) RStudio

31. What is the class defined in the following R code?
g <- c(FALSE, 2)
(b) Numeric

32. Which one of the following is not a basic datatype?
(B) Numeric (C) Data frame

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Matrix & Plotting in R

1. a<-3/2
b<-5/6
c<-0.192
d<-5
e<-2
((a*log(d))/factorial(d))-(a*b*c*d)/(a+b+c*d)-choose(d,e)*(a+e)
(a+b+c+d+e)*log(e)-choose(e,2)-d/e

Output:-
a<-32
b<-5/6
c<-0.192
d<-5
e<-2
((a*log(d))/factorial(d)))-(a*b*c*d)/(a+b+c*d)-choose(d,e)*(a+e) → -35.34425
(a+b+c+d+e)*log(e)-choose(e,2)-d/e → 3.102458

2. x<-c(1,2,3,4,5,6,7,8,9,10)

x[7]
Output:-7

x[6]
Output:-6

x[-7]
Output:-1 2 3 4 5 6 8 9 10

x[-6]
Output:-1 2 3 4 5 7 8 9 10

x[20]
Output:-NA

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3. x<-c(12,23,34,45,56,67,98,78)
x[c(2,6,8)]
Output:
-20 20 19

4. a<-c(10,-20,-100,30,5,20,16,19)
a[6]
a[-c(2,6,8)]
Output:
20
10 -100 30 5 16

5. matrix(c(1,2,3,4), nrow=2, ncol=2, byrow=FALSE)
Output:

1	3
2	4

6. A<-matrix(c(1,3,5,-10,7,0,5,6,3,12,-0,1), nrow=3, ncol=3, byrow=TRUE)
B<-matrix(1,0,0,0,-5,516,3,3,-9), nrow=3, ncol=3, byrow=TRUE)
A+B
Output:

2	3.0	5.000000
-10	2.0	5.333333
9	4.5	-9.400000

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A*B #

Output:

1	0.0	0.000000
0	-35.0	4.166667
18	4.5	0.900000

A-B

Output:

0	3.0	5.00000
-10	12.0	4.166667
3	-1.5	8.900000

A/B

Output:

1	Inf	Inf
-Inf	-1.4	0.60000000
2	0.5	0.0111111

A %/% B

Output:

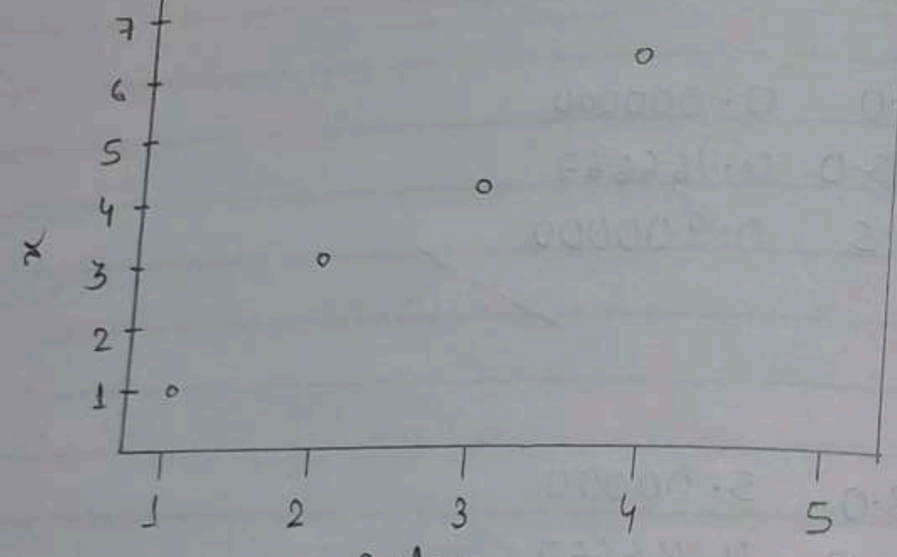
16.0	0.0	-42.50000
5.0	-20.0	-39.16667
5.7	-7.8	2.15000

a <- matrix(c(1,2,3,5,6))

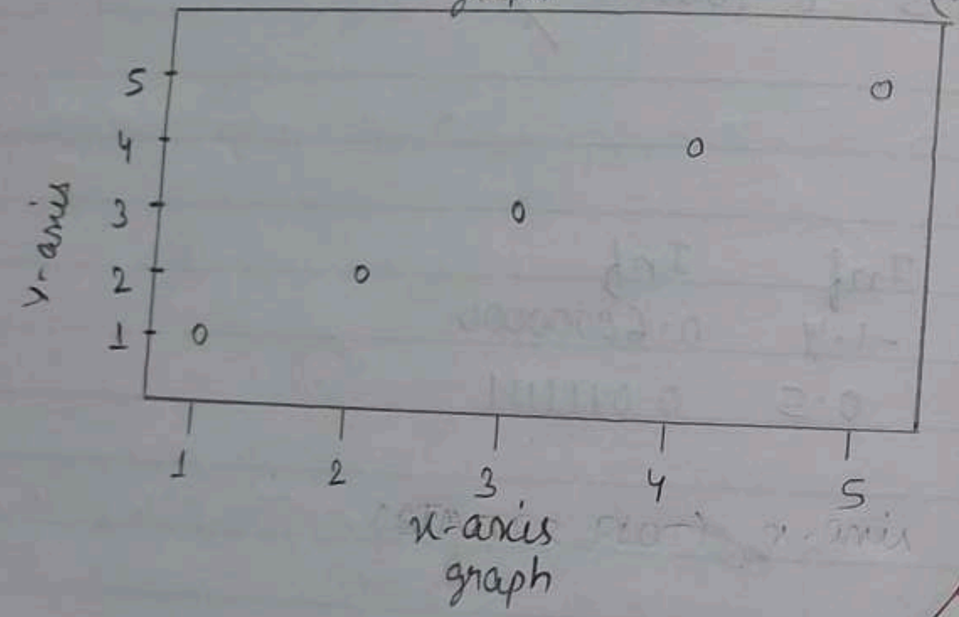
Output

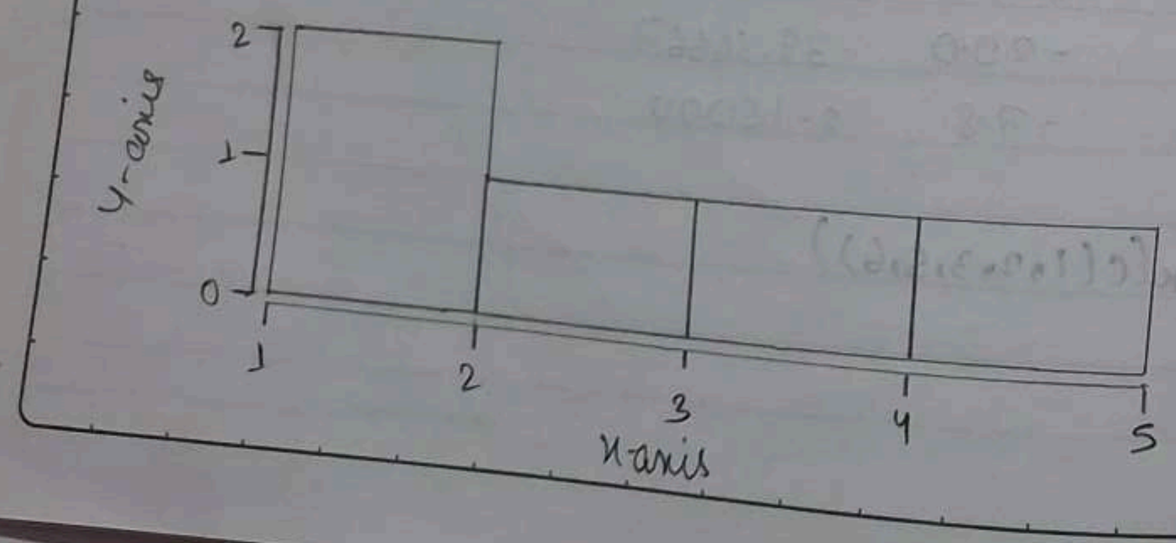
Teacher's Signature:

(DOT PLOT)



(SCATTER PLOT)





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1
2
3
5
6

Plotting in R:-

(i) Dot Plot
(ii) Scatter plot
(iii) Histogram plot
(iv) Piechart or circle plot

(i) Dot Plot

```
x<-c(1,3,4,6,7)
plot(x)
```

(ii) Scatter Plot

```
x<-c(1,2,3,4,5)
y<-c(2,3,4,6,7,8,9)
plot(x, xlab="x-axis", ylab="y-axis"
, main="Graph", cex=2, col="black")
```

(iii) Histogram Plot

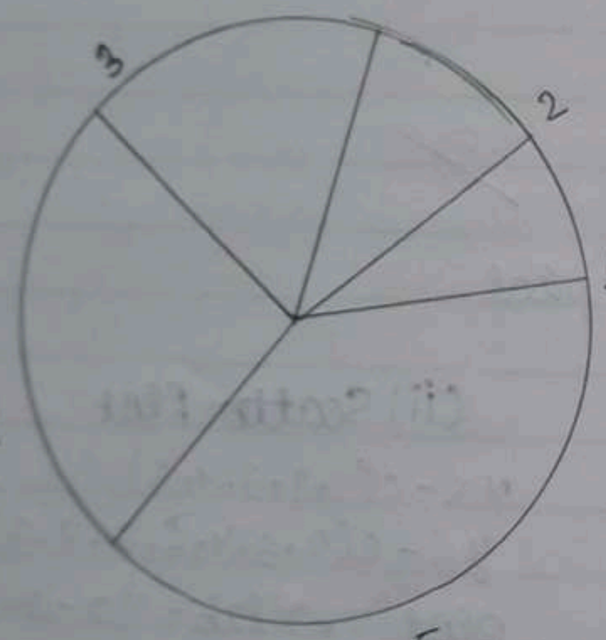
```
x<-c(1,2,3,4,5)
hist(x, xlab="x-axis", ylab="y-axis", main="Graph",
     cex=2, col="white", border="black")
```

(iv) Pie plot

```
x<c(1,2,3,4,5)
pie(x, xlab="24/CSE-DS/056", ylab="R language",
    main="hit", cex=4, col="white", border="black")
```

Teacher's Signature

hit



R language

24/CSE-DS/056

pie plot

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Assignment No. -02

1(a) a<-matrix(c(7,5,-5,2,56,0,15,12,56), nrow=3, ncol=3, byrow=FALSE)

det(a)

t(a) #inverse of matrix A

solve(a)

Output:

```
     7  2  15
     5 56  12
    -5  0  56
```

det(a)	solve(a)		
25472	0.1231158	-0.0043969849	-0.0320351759
t(a)	-0.0134799	0.0183338568	-0.0005533291
7 5 -5	0.0109246	-0.0003925879	0.0149968593
2 56 0			
15 12 56			

(b) a<-matrix(c(1,50,12,2,9,4,3,56,56), nrow=3, ncol=3, byrow=FALSE)

det(A)

t(a)

solve(a)

```
   1  2  3
  50  9 56
  12  4 56
```

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Output :-

```
det(a)                    solve(a)
-3700                -0.07567568  0.027027027 -0.02297297
t(a)                  0.57513514 -0.005405405 -0.02540541
 1  50  12            -0.02488486 -0.005405405  0.02459459
 2   9   4
 3  56  56
solve(a)

(c) a<-matrix(c(56,56,1,56,56,0,2,56,56),nrow=3,ncol=3,
byrow=FALSE)
det(a)
t(a)
solve(a)

Output :-
  56  56  2
  56  56  56
  1   0   56
det(a)                    solve(a)
3024                 1.037037037 -1.037037037  1
t(a)                 -1.018518518  1.036375661 -1
  56  56  1            -0.01851852  0.01851852  0
  56  56  0
  2   56  56
(d) a <- matrix(c(0,56,-0.9,0.82,1/2,0.47,-0.33,56,56),nrow=3,
ncol=3, byrow=FALSE)
det(a)
t(a)
solve(a)
```

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Output:

0 0.82 -0.33
56 1/2 56
-0.9 0.47 56

det(a)
-2621.682

solve(a)
-0.00064081 0.0175746327 -0.0175784
1.21540289 0.0001132860 0.0070491
-0.01021100 0.0002814987 0.0175157

t(a)
0.00 56.0 -0.90
0.82 0.5 0.47
-0.33 56.0 56.00

2. a <- matrix(c(1,3,2,0,4,3,1,5,4), nrow=3, ncol=3, byrow=FALSE).

det(a)

solve(a)

t(a)

Output:-

det(a)

2

solve(a)
0.5 0.5 -2
-1.0 1.0 -1
0.5 -1.5 2

t(a)
1 3 2
0 4 3
1 5 4

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3. a<-matrix(c(56,-2,1,-2,56,7,1,7,56), nrow=3, ncol=3, byrow=FALSE)
det(a)
solve(a)
t(a)

Output:-

det(a)
172564
solve(a)

0.01788 90151	0.000689 5992	-0.0004056466
0.0006895992	0.01816 71728	-0.0022832409
-0.0004056466	-0.0022832109	0.01814 97879

t(a)

56	-2	1
-2	56	7
1	7	56

4. a<-matrix(c(1/2,-1,1/2,3/2,1,-3/2,-2,-1,2), nrow=3, ncol=3, byrow=FALSE)
b<-matrix(c(-0.51,0.23,56,56,30,0.61,0.55,0.4), nrow=3, ncol=3, byrow=FALSE)
a*b
a.*.b
a-b
a+b

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Output:-

```
a*b
  -0.255  84.000  -1.10
  -0.230  30.000  -0.40
  28.000  -0.915  -1.02
a%*%b
  -111.91  71.78  1.895
  -55.25  -26.61  0.360
  111.40  -15.78  -1.345
a-b
  1.01  -54.50  -2.55
  -1.23  -29.00  -1.40
  -55-50  -2.11  2.51
```

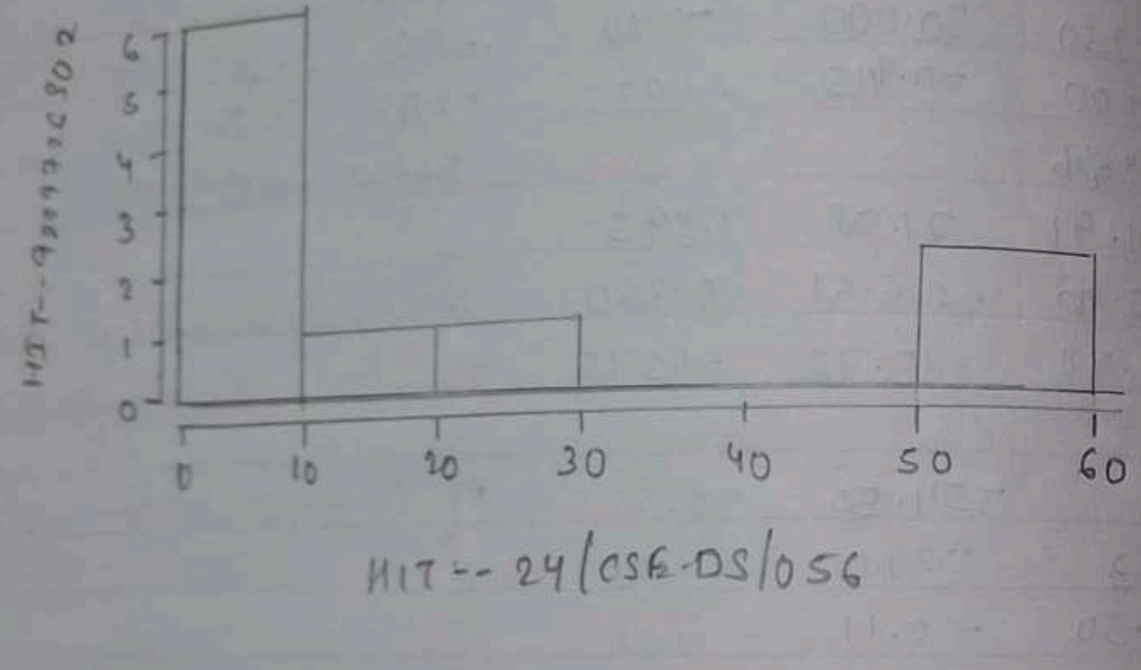
```
a<-matrix(c(1,2,2,3,3,56),nrow=2,ncol=3,byrow=FALSE)
b(-matrix(c(21,3.3,56,2.1,23,1.4),nrow=2,ncol=3,byrow=
FALSE)
a*b
a+b
a-b
```

Output:-

```
a*b
  21.0  112.0  69.0
  0.6  6.3  78.4
a+b
  22.0  58.0  26.0
  5.3  5.1  57.4
a-b
  -20.0  -54.0  -20.0
  -1.3  0.9  54.6
```

Kwt 22/8/25

Teacher's Signature:



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6. ~~a<-matrix(c(7,5,-5,2,56,0,15,12,~~

7. x<-c(2,6,56,9,4,0,1,56,22,15)
hist(x, xlab="HIT--24/CSE-DS/056", ylab="HIT--9229726302", main="histogram -- Maunita Mandal", cex=3, col="pink", border="white")

8. a<-matrix(c(1,2,2,3,3,1), nrow=2, ncol=3, byrow=FALSE)

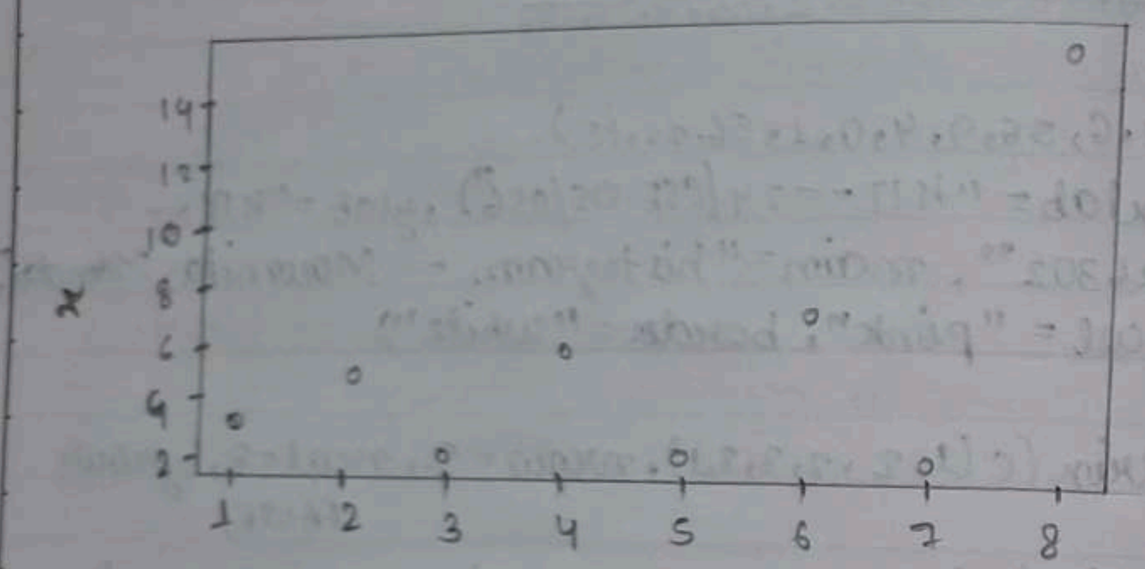
b<-matrix(c(21,3.3,22,2.1,23,1.4), nrow=2, ncol=3, byrow=FALSE)

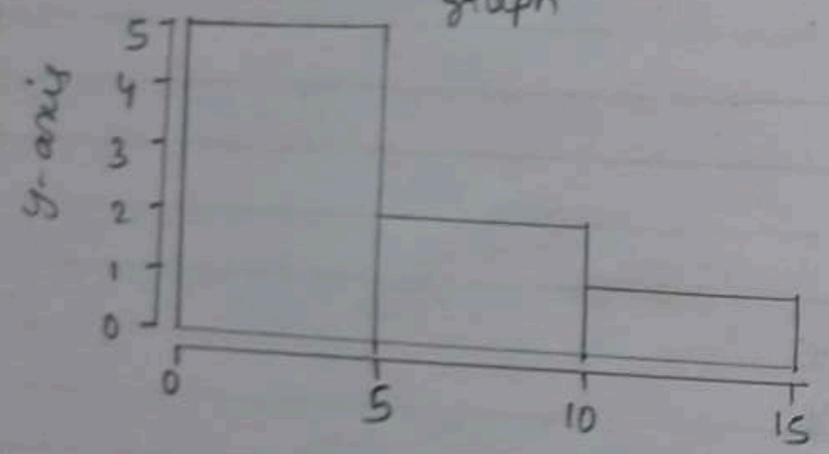
a*b
a+b
a-b

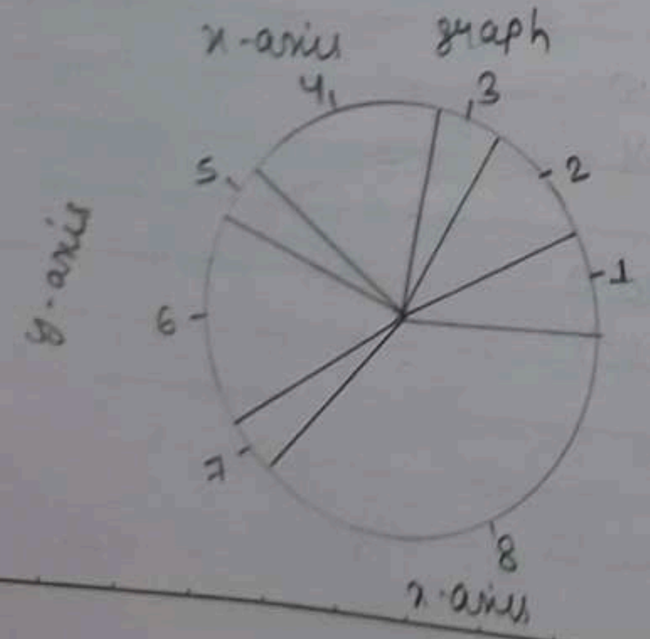
Output:

a*b
```
   21.0  44.0  69.0
    6.6   6.3   1.4
```
a+b
```
   22.0  24.0  26.0
    5.3   5.1   2.4
```
a-b
```
  -20.0 -20.0 -20.0
   -1.3   0.9  -0.4
```

Teacher's Signature:







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Q.

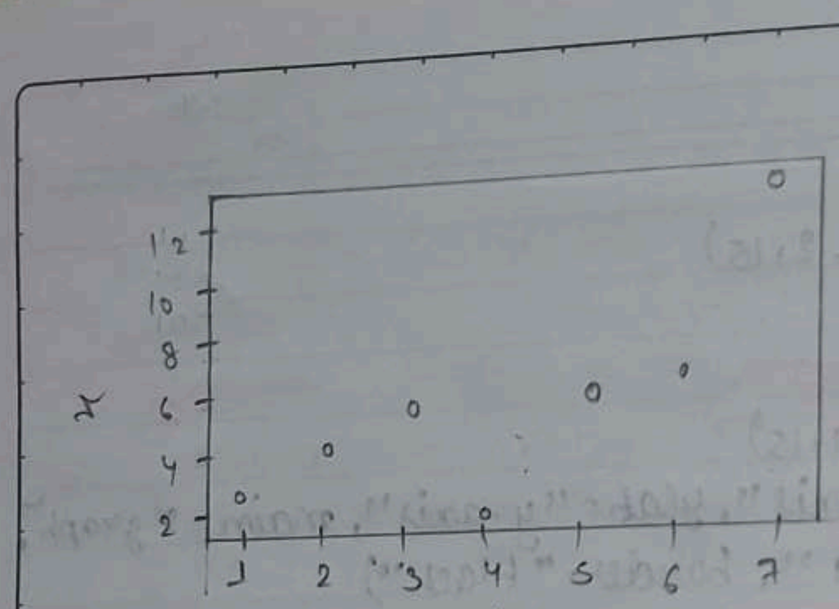
(a)
```
x<-c(3,5,2,6,2,7,2,15)
plot(x)
```

```
x<-c(3,5,2,6,2,7,2,15)
hist(x, xlab="x-axis", ylab="y-axis", main="graph",
cex=2, col="white", border="black")
```

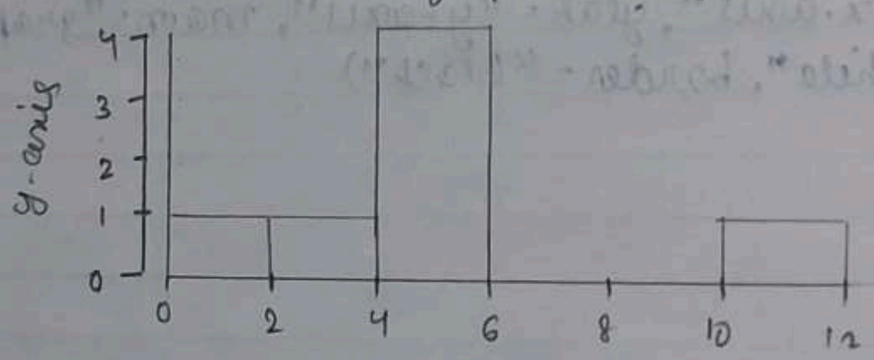
```
x<-c(3,5,2,6,2,7,2,15)
pie(x, xlab="x-axis", ylab="y-axis", main="graph",
cex=2, col="white", border="black").
```

(b)

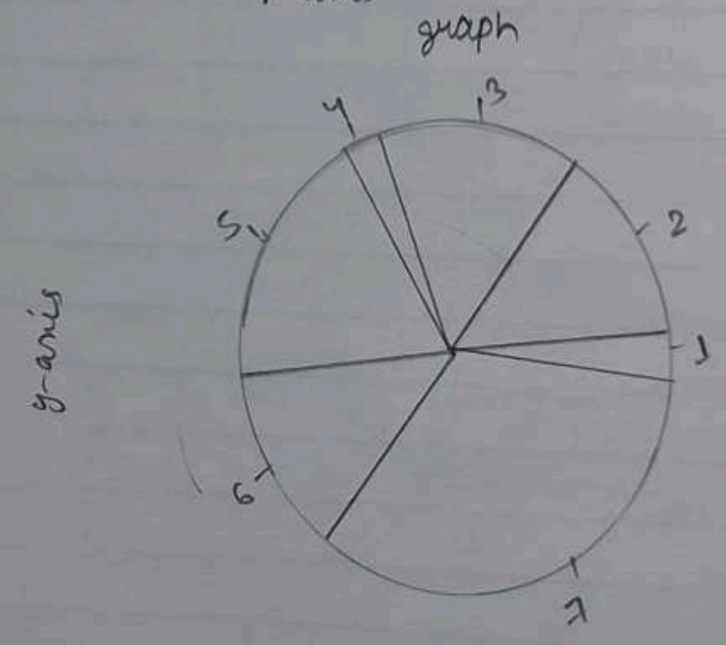
Teacher's Signature:



graph



graph



Experiment Name / No.:

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(b)
```
x<c(2.3,4.4,5.6,1.2,5,6,12)
plot(x)

x<-c(2.3,4.4,56,1.2,5,6,12)
hist(x,xlab="x-axis",ylab="y-axis",main="graph",
cex=2,col="white",border="black")

x<-c(2.3,4.4,5.6,1.2,5,6,12)
pie(x,xlab="x-axis",ylab="y-axis",main="graph",
cex=2,col="white",border="black")
```

Teacher's Signature

Output:-

```
'data.frame' : 6 obs. of 2 variables:
 $ x: num  1 1 2 3 9 10
 $ y: num  10 20 30 40 50 60
```

```
summary(x)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  1.000   1.250   2.500   4.333   7.500  10.000
```

```
Summary(y)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   10.0    22.5    35.0    35.0    47.5    60.0
```

```
> quantile(y, probs = c(0.25, 0.50, 0.75))
  25%   50%   75%
 22.5  35.0  47.5
```

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Data frames

```
Name<-c("Moumita","Khushi")
RollNO<-c(56,43)
x<-data.frame(Name,RollNO)
str(x)
```

Output:-

```
  Name    RollNO
1 Moumita    56
2 Khushi     43
```

```
Name<-c("Moumita","Khushi")
RollNO<-c(56,43)
x<-c(data.frame(Name,RollNO))
str(x)
```

Output:-

```
List of 2
 $ Name  : chr [1:2] "Moumita" "Khushi"
 $ RollNO.: num [1:2] 56 43
```

```
x<-c(1,1,2,3,9,10)
y<-c(10,20,30,40,50,60)
x<-data.frame(x,y)
str(x)
summary(x)
summary(y)
quantile(y, prob<-c(0.25,0.50,0.75)
```

Khushi 21/8/25

Teacher's Signature:

Output:

	Name	City	state	Phone	fax	Email
1.	IIT Bombay	Mumbai	Maharashtra	022-257 22545	022- 25	@iitb.in
2.	IIT Delhi	New Delhi	Delhi	011-2659 7135	011- 265	@iitd.in
3.	IIT kanpur	Kanpur	Uttar Pradesh	0512- 2590151	0542- 259	@iitk.in
4.	IIT Kharagpur	Kharagpur	West Bengal	0322- 255221	0322- 2553	@iitkgp.in
5.	IIT Madras	Chennai	Tamil Nadu	044- 225782	044- 2257	@iitm.in
6.	IIT Roorkee	Roorkee	Uttarakhand	01332- 255221	0133- 285	@iitr.in
7.	IIT Guwahati	Guwahati	Assam	0361-2582 000	0361- 2583	@iitg.in
8.	IIT BHU	Varanasi	Uttar Pradesh	0542- 2367780	0542- 236	@iitbhu.in
9.	IIT Hyderabad	Hyderabad	Telangana	040-230160 33	040- 2301	@iith.in
10.	IIT Indore	Indore	Madhya Pradesh	0731-2438 717	0361- 258	@iiti.in

Experiment Name / No.:

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Assignment No. 03

1)

a) Create a data frame in R containing ten IITs, including name, city, state, Phone number, Fax number and email address.

⇒ Name <- c("IIT-Bombay", "IIT Delhi", "IIT kanpur", "IITKGP", "IIT Madras", "IIT Guwahati", "IIT BHU", "IIT Hyderabad", "IIT Indore").

City <- c("Mumbai", "New Delhi", "Kanpur", "Kharagpur", "Chennai", "Roorkee", "Guwahati", "Varanasi", "Hyderabad", "Indore")

State <- c("Maharastra", "Delhi", "Uttar Pradesh", "west Bengal", "Tamil Nadu", "Uttarakhand", "Assam", "Uttar Pradesh", "Telangana", "Madhya Pradesh")

Phone <- c("022-25722545", "011-26597135", "0512-2590151", "0322-255221", "044-22578200", "01332-255221", "0361-2582000", "0542-2367780", "040-23016033", "0731-2438717")

Fax <- c("022-25", "011-265", "0542-259", "0322-2553", "044-2257", "01332-285", "0361-2583", "0542-236", "040-2301", "0361-256").

Teacher's Signature

Output:

	Name	City	State	Phone	Fax	Email
1.	NIT Trichy	Tiruchirappalli	Tamil Nadu	0431-2501801	0431	@nitt.edu
2.	NIT Warangal	Warangal	Telangana	0870-2549191	0870	@nitw.edu
3.	NIT Surathkal	Mangalore	Karnataka	0824-247400	0824	@nitk.edu
4.	NIT Rourkela	Rourkela	Odisha	0495-2287250	0661	@nitrkl.edu
5.	NIT Calicut	Calicut	Kerala	0661-2462999	0495	@nitc.edu
6.	NIT Durgapur	Durgapur	West Bengal	0343-24563	0343	@nitdgp.edu

Experiment Name / No.:

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```
Email <- c("@iitb.in", "@iid.in", "@iitk.in", "@iitkgp.in",
"@iitn.in", "@iitr.in", "@iitg.in", "@iitg.in", "@iitbhu.in",
"@iith.in", "@iit.i.in")

IITs <- data.frame(Name, city, state, Phone, Fax, Email)
```

(b) Create a data frame in R containing six NITs, name, city, phone, fax, email address.

```
Name <- c("NIT Trichy", "NIT Warangal", "NIT Surathkal",
"NIT Rourkela", "NIT Calicut", "NIT Durgapur")

City <- c("Tiruchirappali", "Warangal", "Mangalore",
"Rourkela", "Calicut", "Durgapur")

State <- c("Tamil Nadu", "Telangana", "Karnataka",
"Odisha", "Kerala", "West Bengal")

Phone <- c("0431-2501801", "0870-2549191", "0824-247400",
"0661-2462999", "0495-2287250", "0345-24563")

Fax <- c("0431", "0870", "0824", "0661", "0495", "0343")

Email <- c("@nitt.edu", "@nitw.edu", "@nitk.edu",
"@nitr.edu", "@nitc.edu", "@nitdgp.in")

NITs <- data.frame("Name", city, state, phone, Fax, Email)
```

Teacher's Signature:

2.(a) Output:

```
sum(x)
58
mean(x)
7.25
sd(x)
10.6066
Prod(x)
66528
median(x)
3.5
```

(b) Output:

```
det(A)
25472
t(a)
     7    5   -5
     2   56    0
    15   12   56
solve(a)
0.01231558    -0.004396849   -0.03203517859
-0.01334799   0.0183338568   -0.0003533291
0.01099246    -0.0003925879  0.01499685943

det(b)
-2621.682
t(b)
0.00    56.0    -0.90
0.82    0.5     0.47
-0.33   56.0    56.00

solve(b)
-0.0006401    0.01757463127   -0.01757241
1.2540289     0.0001132860    0.00704891
-0.0102100    0.0002814987    0.01751547
```

Experiment Name / No.:

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3. Write a code of sum, mean & s.d, product, & median, for (3,4,1,33,6,2,7). Create matrix in R and determine, transpose & inverse.

```
x<-c(3,4,1,33,2,6,2,7)
sum(x)
mean(x)
sd(x) #standard deviation
prod(x)
median(x)

a<-matrix(c(7,5,-5,2,56,0,15,12,56), nrow=3, ncol=3,
          byrow=FALSE)
det(a)
t(a)
solve(a)

b<-matrix(c(0.56,-0.9,0.82,1/2,0.47,-0.33,56,56), nrow=3,
ncol=3, byrow=FALSE)
det(b)
t(b)
solve(b)
```

Teacher's Signature:

Output:

Name	Home	MobileNO	RollNO	Age
Khushi	Ranchi	6726340269	34	20
Moumita	Sarsa	9856326587	32	18
Nandani	Dumka	8976542967	76	19
Madhu	Shikaripara	7856322187	89	17
Tannu	Ranchi	9867542365	56	21
Amrida	Ranchi	8765341267	43	18
Monami	Dumka	5432875609	23	14

'data.frame': 7 obs. of 5 variables:
$ Name : Factor w/7 levels "Amrida", "Khushi", ...: 2 5 6 3 7 1 4
$ Home : Factor w/4 levels "Dumka", "Ranchi", ...: 2 3 1 4 2 3 1
$ MobileNo: num 6.73e+09 9.86e+09 8.99e+09 7.86e+09 9.87e+09
$ RollNo : num 34 32 76 89 56 43 23
$ Age : num 20 18 19 17 21 18 14

Summary (Friends)

Name	Home	MobileNo	RollNo	Age
Amrida : 1	Dumka : 2	Min : 5.433e+09	Min : 23.00	Min : 14.00
Khushi : 1	Ranchi : 3	1st Qu. : 7.305e+09	1st Qu : 33.00	1st Qu : 17.50
Madhu : 1	Sarsa : 1	Median : 8.265e+09	Median : 43.00	Median : 18.00
Monami : 1	Shikaripara : 1	Mean : 8.216e+09	Mean : 50.43	Mean : 18.29
Moumita : 1		3rd Qu : 9.416e+09	3rd Qu : 66.00	3rd Qu : 19.50
Nandani : 1		Max. : 9.898e+09	Max. : 89.00	Max. : 21.00
Tannu : 1				

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3. Name <- c("Khushi", "Moumita", "Nandani", "Madhu", "Tannu", "Amrita", "Monami")
Home <- c("Ranchi", "Sarsa", "Dumka", "Shikaripara", "Ranchi", "Dumka")
MobileNO <- c(6726340269, 9856326587, 8976542967, 7856322187, 9867542365, 8765341267, 5432875609)
RollNO. <- c(34, 32, 76, 89, 56, 43, 23)
Age <- c(20, 18, 19, 17, 21, 18, 14)
data.frame(Name, Home, MobileNO, RollNO, Age)
Friends <- data.frame(Name, Home, MobileNO, RollNO, Age)
str(Friends)
summary(Friends)
subjects <- c("Mathematics", "Physical Science", "Chemistry", "Data science", "Bengali", "Oriya", "Hindi")
data.frame(Name, Home, MobileNO, RollNO, Age, subjects)
Friends[c(4,5)] OR
Friends[4:5]

Teacher's Signature:

Name	Home	MobileNO	RollNO	Age	Subjects
Khushi	Ranchi	6754238965	34	20	Mathematics
Moumita	Sahibganj	8856326587	32	18	Physical science
Nandani	Dumka	8976541367	76	19	Chemistry
Madhu	Shikaripara	7856321487	89	17	Data science
Tannu	Ranchi	8864541265	56	21	Bengali
Ameida	Ranchi	9765341247	43	18	Oriya
Monami	Dumka	5432875609	23	14	Hindi

for friends [4:5]

RollNO	Age
34	20
32	18
76	19
89	17
56	21
43	18
23	14

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```
day <- c("___", "Mon", "Tue", "wed", "Thu", "Fri")
first-class <- c("9:40-10:30", "PCC-DS-302", "BSC-DS-301",
  "ESC-DS-391", "<NA>", "ESC-DS-392")
second-class <- c("10:30-11:20", "ESC-DS-302", "PCC-DS-301",
  "ESC-DS-392", "<NA>", "ESC-DS-392")
third-class <- c("11:20-12:10", "ESC-DS-303", "ESC-DS-301",
  "ESC-DS-392", "<NA>", "ESC-DS-392")
fourth-class <- c("12:10-13:00", "ESC-DS-301", "PDCC", "<NA>",
  "<NA>", "<NA>")
fifth-class <- c("1:00-1:50", "<NA>", "<NA>", "<NA>", "<NA>",
  "<NA>")
routine <- data.frame(day, first-class, second-class, third-class,
fourth-class, fifth-class)
print(routine, row.names = FALSE)
```

Prut.
27/8/21

Teacher's Signature:

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Distribution function

Random variable
Discrete → Pmf → Binomial, Bernoulli and Polynomial
Continuous → Pdf

Binonomial Distribution in R

pmf → $n(x p^{*}(1-p)^{n*}$
where $q = 1-p$

Ex: n<-4
x<-3
p<-1/2
choose(4,3)*(1/2)^3*(1-0.5)^1
Output:
0.25

Binomial in R

pmf	cdf	Quantile	RV
dbinom (x, size, prob)	Pbinom() ↓	qbinom(pmf, size, prob) ↓	rbinom(3,4,1/2) Output: 3 1 2
dbinom(3,4,1/2)	Pbinom (3,4,1/2)	qbinom(0.9375 4,1/2)	
dbinom(3, size=4, prob=1/2)	Output: 0.9375	Output: 3	
Output: 0.25			

Teacher's Signature:

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Random variable

It is a function from sample space to real number.

rbinom (n, size, prob)

set.seed(100)
rbinom(3, 4, 1/2) # binomial random variable generate

Output :-

1 1 2

Q: To generate 10 fired R is from Binomial distribution function calculate pmf and cdf ~ n = 50, p = 3/4

⇒ set.seed(100)
rbinom (10, 50, 3/4)
dbinom (10, 50, 3/4)
pbinom (10, 50, 3/4)

Output

39 40 37 42 38 38 35 39 37 40

dbinom

4.784976e-16

pbinom

5.203604e-16

d → pmf / pdf
p → cdf
q → quantile
r → random variable

Teacher's Signature:

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Bernoulli in R

pmf	cdf	quantile
e.g:-	pbern(x, prob)	qbern(x, prob)
dbern(x, prob)		
	library(Rlab)	library(Rlab)
library(Rlab)	pbern(1, 1/2)	qbern(1, 1/2)
dbern(1, 1/2)	Output:-	Output
Output:-	1	1
0.5		

Kunal 12/9/24

Discrete Distribution:-

(i) Binomial
(ii) Bernoulli
(iii) Poisson

→ dbinom()
→ pbinom()
→ qbinom()
→ rbinom()

(ii) Bernoulli

→ dbern()
→ pbern()
→ qbern()
→ rbern()

(iii) Poisson

→ dPoisson(x, rate)
→ pPois(x, λ)
→ qPois( )
→ rPois( )

Teacher's Signature:

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package → library(RLab)

Poisson distribution:

$$f(x,\lambda) = \frac{e^{-\lambda} \cdot \lambda^x}{x!}$$

dPois(x, rate(λ))

pPois(x,λ)

qPois( )

rPois( )

example:- dPois(2,5)

output:- 0.08422434

ppois(2,5)

output : 0.124652

x<-5

y<-7

(exp(-y)*(y^x)) / factorial(x)

Output:-

0.1277167

ppois(5,7) = 0.3007083

rpois(5,7)

output:-

11 9 5 8 8

Teacher's Signature:

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Continuous distribution :

- Exponential
  - dexp(x, λ)
  - pdf
  - p
  - r
  - q
- Normal
  - Standard Normal

```
dexp(5,10)
```

Output :

1.92875e-21

```
pexp(5,10)
qexp(5,10)
rexp(5,10)
```

Output :

1

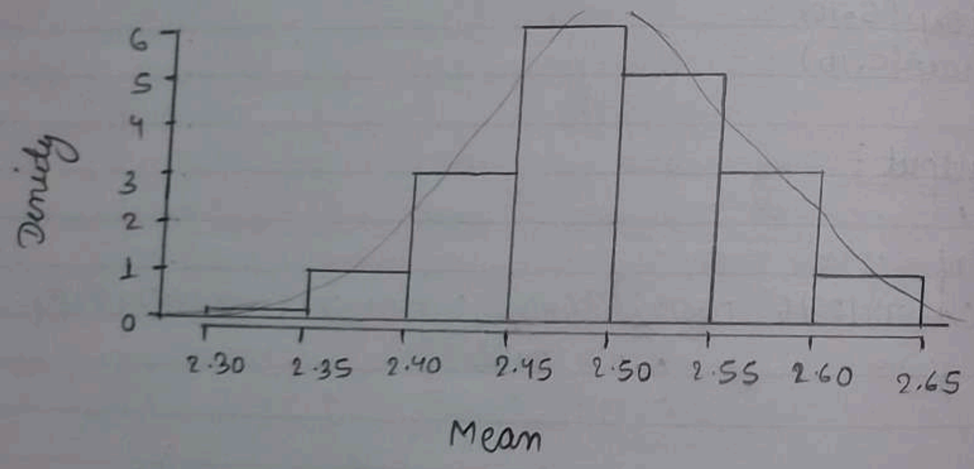
Inf

0.13781276 0.02667663 0.21245723 0.04778480

0.27134186

Knit:
19/9/25

Teacher's Signature:



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Assignment No.04

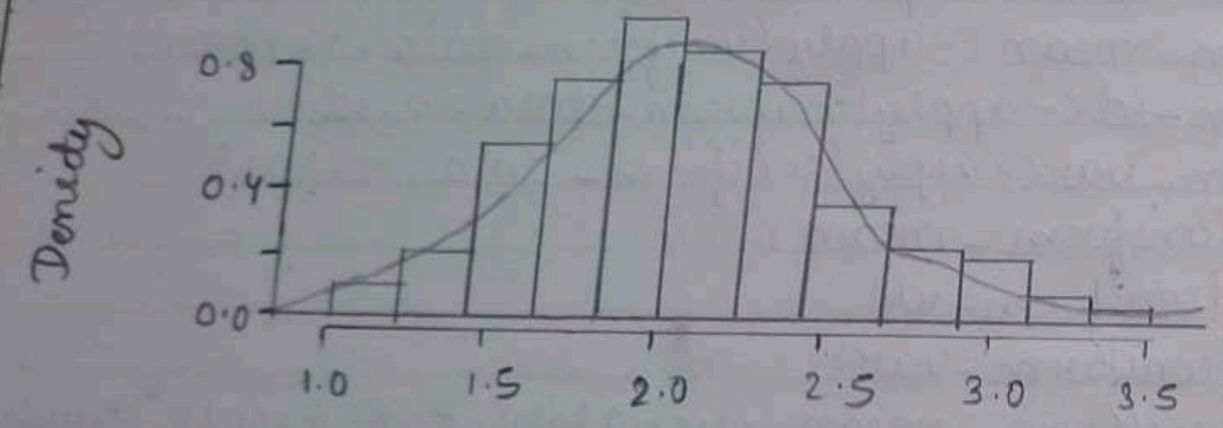
1. Generate 500 sets of 20 data from uniform distribution in interval (2,3). Then find mean, standard Deviation and variance.

```
set.seed(123)
uniform_data <- replicate(500, runif(20, min=2, max=3))
uniform_mean <- apply(uniform_data, 2, mean)
uniform_sd <- apply(uniform_data, 2, sd)
uniform_var <- apply(uniform_data, 2, var)
mean(uniform_mean)
mean(uniform_sd)
mean(uniform_var)
hist(uniform_mean, probability=TRUE, col="skyblue",
main="uniform Distribution", xlab="Mean")
lines(density(uniform_mean), col="red", lwd=2)
```

Output:

```
mean(uniform_mean)
2.497
mean(uniform_sd)
0.285
mean(uniform_var)
0.082
```

Teacher's Signature:



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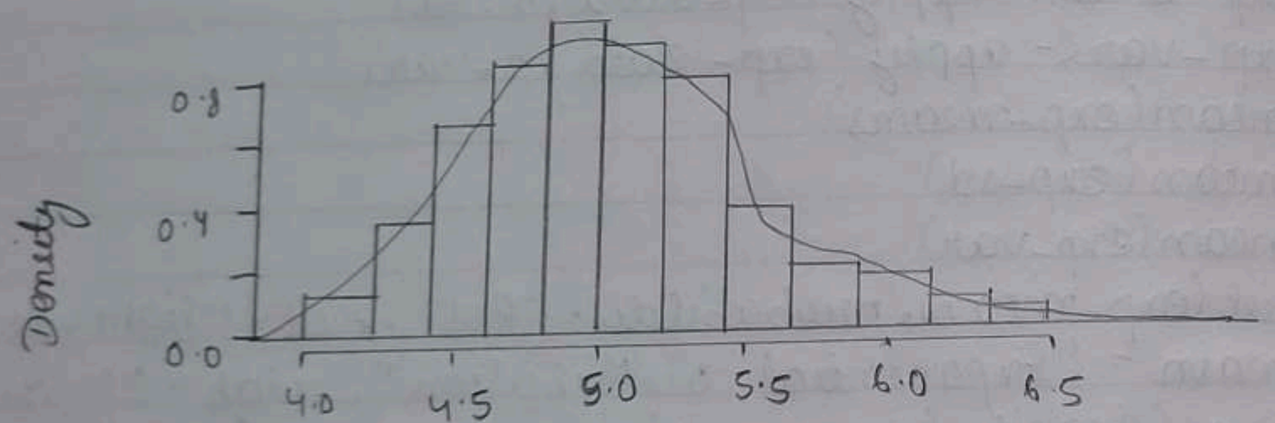
2. Generate 500 sets of 20 data from exponential distribution with scale parameter 2. find mean, sd and var.

```
set.seed(123)
exp_data <- replicate(500, rexp(20, rate = 1/2))
exp_means <- apply(exp_data, 2, sd)
exp_var <- apply(exp_data, 2, var)
mean(exp_means)
mean(exp_sd)
mean(exp_var)
hist(exp_means, probability = TRUE, col = "lightgreen",
main = "Exponential Distribution", xlab = "Mean")
lines(density(exp_means), col = "red", lwd = 2)
```

Output :

```
mean(exp_means)
2.007
mean(exp_sd)
1.924
mean(exp_var)
4.024
```

Teacher's Signature



Experiment Name / No.:

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3. Generate 500 set of 20 data from exponential distribution with scale parameter 2 and location parameter 3. Find mean, sd, var.

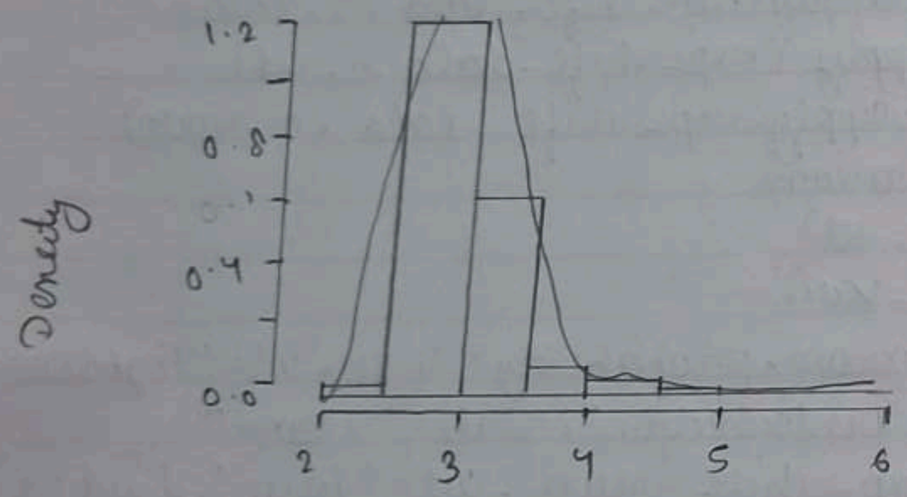
```
set.seed(123)
exp_shift_data <- replicate(500, rexp(20, rate=1/2)+3)
exp_shift_mean <- apply(exp_shift_data, 2, mean)
exp_shift_sd <- apply(exp_shift_data, 2, sd)
exp_shift_var <- apply(exp_shift_data, 2, var)
mean(exp_shift_mean)
mean(exp_shift_sd)
mean(exp_shift_var)
hist(exp_shift_mean, probability=TRUE, col="lightcoral",
main = "shifted Distribution", xlab = "Mean")
lines(density(exp_shift_mean), col="blue", lwd=2)
```

Output :-

```
Mean(exp_shift_mean)
5.007
Mean(exp_shift_sd)
1.924
Mean(exp_shift_var)
4.024
```

Teacher's Signature:

Pareto Distribution



Experiment Name / No.:

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4. Generate 500 sets of 20 data from pareto distribution with scale parameter 2 and shape parameter 3. Find mean, sd, var.

```
set.seed(123)
pareto_data <- replicate(500, {u <- runif(20) 2*
                              (1-u)^(-1/3)})
pareto_mean <- apply(pareto_data, 2, mean)
pareto_sd <- apply(pareto_data, 2, sd)
pareto_var <- apply(pareto_data, 2, var)
mean(pareto_mean)
mean(pareto_sd)
mean(Pareto_var)
hist(pareto_mean, probability = TRUE, Col = "Orange",
main = "pareto Distribution", xlab = "Mean")
lines(density(pareto_mean), col = "red", lwd = 2)
```

Output :

```
mean(pareto_mean)
2.981
mean(pareto_sd)
1.311
mean(pareto_var)
2.724
```

Teacher's Signature: