

MA3251 STATISTICS AND NUMERICAL METHODS
PART A & B QUESTIONS
UNIT I
TESTING HYPOTHESIS
PART - A

1. Mention the various steps involved in testing of hypothesis. (A.U.A/M 2010)
2. Define Chi-Square test for goodness of fit. (A.U.A/M 2010)
3. What are parameters and statistics in sampling? (A.U.N/D 2010)
4. Write any two applications of ψ^2 -test. (A.U.N/D 2010), (A.U.M/J 2012)
5. What are the applications of t -distributions? (A.U.A/M 2011)
6. Define Type I and Type II errors in taking a decision. (A.U.A/M 2011, M/J 2012, N/D 2013, M/J 2014)
7. What are the null and alternative hypotheses?

a	b
c	d

 (A.U.N/D 2012, A/M 2015)
8. Give the formula for the ψ^2 -test of independence for (A.U.N/D 2012, N/D 2014)
9. State level of significance. (A.U.N/D 2013)
10. State the conditions for applying ψ^2 -test. (A.U.M/J 2014)

PART – B

11. A sample of 900 members has a mean 3.4cm and standard deviation 2.61cm. Is the sample from a large population of mean 3.25cms and standard deviation of 2.61cms? (A.U.A/M 2010)
12. Before an increase in excise duty on tea, 800 persons out of a sample of 1,000 persons were found to be tea drinkers. After an increase in duty, 800 people were tea drinkers in a sample of 1,200 people. Using standard error of proportion, state whether there is a significant decrease in the consumption of tea after the increase in excise duty? (z_{α} at 5% level 1.645, 1% level 2.33). (A.U.A/M 2010)
13. Out of 8000 graduates in a town 800 are females, out of 1600 graduate employees 120 are females. Use χ^2 to determine if any distinction is made in appointment on the basis of sex. Value of χ^2 at 5% level for one degree of freedom is 3.84. (A.U.A/M 2010)
14. An automobile company gives you the following information about age groups and the liking for particular model of car which it plans to introduce. On the basis of this data can it be concluded that the model appeal is independent of the age group. ($\chi^2_{0.05(3)} = 7.815$)

	Age Group			
Persons who :	Below 20	20 – 39	40 – 59	60 and above
Liked the car :	140	80	40	20
Disliked the car :	60	50	30	80

(A.U.A/M 2010)

15. A machine produces 16 imperfect articles in a sample of 500. After machine is overhauled, it produces 3 imperfect articles in a batch of 100. Has the machine been improved? (A.U.N/D 2010, N/D 2012)
16. Examine whether the difference in the variability in yields is significant at 5% level of significance, for the following. (A.U.N/D 2010)

	Set of 40 plots	Set of 60 plots
Mean yield per plot	1256	1243
S.D. per plot	34	28

17. Test if the difference in the means is significant for the following data: (A.U.N/D 2010)

Sample I:	76	68	70	43	94	68	33	-
Sample II:	40	48	92	85	70	76	68	22

18. The following data gives the number of aircraft accidents that occurred during the various days of a week. Find whether the accidents are uniformly distributed over the week. (A.U.N/D 2010)

Day :	SUN	MON	TUE	WED	THUR	FRI	SAT
No. of accidents:	14	16	8	12	11	9	14

19. In a random sample of 1000 people from city A, 400 are found to be consumers of wheat. In a sample of 800 from city B, 400 are found to be consumers of wheat. Does this data give a significant difference between the two cities as far as the proportion of wheat consumers is concerned? (A.U.A/M 2011)

20. 4 coins were tossed 160 times and the following results were obtained :

No. of heads : 0 1 2 3 4

Observed frequencies : 17 52 54 31 6

Under the assumption that the coins are unbiased, find the expected frequencies of getting 0, 1, 2, 3, 4 heads and test the goodness of fit. (A.U.A/M 2011)

21. The heights of 10 males of a given locality are found to be 70, 67, 62, 68, 61, 68, 70, 64, 64, 66 inches. Is it reasonable to believe that the average height is greater than 64 inches? (A.U.A/M 2011)

22. Test of the fidelity and selectivity of 190 radio receivers produced the results shown in the following table : (A.U.A/M 2011)

Selectivity	Fidelity		
	Low	Average	High
Low	6	12	32
Average	33	61	18
High	13	15	0

Use the 0.01 level of significance to test whether there is a relationship between fidelity and selectivity.

23. A dice is thrown 400 times and a throw of 3 or 4 is observed 150 times. Test the hypothesis that the dice is fair. (A.U.M/J 2012)

24. Theory predicts that the proportion of beans in four groups A, B, C, D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the four groups were 882, 313, 287 and 118. Does the experiment support the theory? (A.U.M/J 2012)

25. The means of two large samples of 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same populations of standard deviation 2.5 inches? **(A.U.M/J 2012)**

26. Two random samples gave the following results:

Sample	Size	Sample Mean	Sum of square of deviation from the mean
1	10	15	90
2	12	14	108

Test whether the samples have come from the same normal population. **(A.U.M/J 2012)**

27. Test whether there is any significant difference between the variance of the population from which the following samples are taken: **(A.U.N/D 2012)**

Samples I: 20 16 26 27 23 22

Samples II: 27 33 42 35 32 34 38

28. A mathematics test was given to 50 girls and 75 boys. The girls made an average grade of 76 with a S.D of 6, while boys made an average grade of 82 with a S.D of 2. Test whether there is any significant difference between the performance of boys and girls. **(A.U.N/D 2012)**

29. A sample of 10 boys had the I.Q's : 70,120,110,101,88,83,95,98,100 and 107. Test whether the population mean I.Q may be 100. **(A.U.N/D 2012)**

30. Random sample drawn from two countries gave the following data relating to the heights of adult males. Is the difference between standard deviation significant? **(A.U.A/M 2013)**

	Country A	Country B
Mean height(in inches)	67.42	67.25
S.D(inches)	2.58	2.50
Number of samples	1000	1200

31. The sales manager of a large company conducted a sample survey in state A and B taking 400 samples in each case. The results were in the following table. Test whether the average sales in the same in the 2 state at 1% level. **(A.U.A/M 2013)**

	State A	State B
Average sales	Rs.2,500	Rs.2,200
S.D	Rs.400	Rs.550

32. 1000 students at college level were graded according to their I.Q. and their economic conditions. What conclusion can you draw from the following data: **(A.U.A/M 2013)**

	Economic conditions		I.Q.Level	
	Rich	Poor	High	Low
Rich	460	140		
Poor	240	160		

33. Time taken by workers in performing a job are given below: **(A.U.N/D 2013)**

Type I : 21 17 27 28 24 23 -
 Type II : 28 34 43 36 33 35 39

Test whether there is any significant difference between the variance of time distribution.

34. 20 people were attacked by a disease and only 18 survived . Will you reject the hypothesis that the survival rate , if attacked by this disease is 85% is favour of the hypothesis that is more at 5% level? **(A.U.N/D 2013)**
35. Before an increase in excise duty on tea, 900 persons out of a sample of 1100 persons were found to be tea drinkers. After an increase in duty, 900 people were tea drinkers in a sample of 1300 people. Using standard error of proportion, state whether there is a significant decrease in the consumption of tea after the increase in excise duty? **(A.U.N/D 2013)**
36. The sales manager of a large company conducted a sample survey in two places A and B taking 200 samples in each case. The results were in the following table. Test whether the average sales in the same in the 2 state at 5% level. **(A.U.N/D 2013)**
- | | Place A | Place B |
|---------------|----------|----------|
| Average sales | Rs.2,000 | Rs.1,700 |
| S.D | Rs.200 | Rs.450 |
37. A manufacturer of light bulbs claims that an average of 2% of the bulbs manufactured by him are defective. A random sample of 400 bulbs contained 13 defective bulbs. On the basis of the sample, can you support the manufacturer's claim at 5% level of significance? **(A.U A/M 2014)**
38. A survey of 320 families with 5 children each revealed the following distribution.
- | | | | | | | |
|-------------------|----|----|-----|----|----|----|
| No. of boys : | 5 | 4 | 3 | 2 | 1 | 0 |
| No. of girls : | 0 | 1 | 2 | 3 | 4 | 5 |
| No. of families : | 14 | 56 | 110 | 88 | 40 | 12 |
- (A.U A/M 2014)**
Is this result Consistent with the hypothesis that male and female births are equally probable?
39. Two independent samples of sizes 9 and 7 from a normal population had the following values of the variables
- | | | | | | | | | | |
|------------|----|----|----|----|----|----|----|----|----|
| Sample I: | 18 | 13 | 12 | 15 | 12 | 14 | 16 | 14 | 15 |
| Sample II: | 16 | 19 | 13 | 16 | 18 | 13 | 15 | | |
- (A.U A/M 2014)**
Do the estimates of population variance differ significantly at 5% level of significant?

UNIT II
DESIGN OF EXPERIMENTS
PART - A

1. Discuss the advantages and disadvantages of Randomized block design. **(A.U.A/M 2010)**
2. State the advantages of a factorial Experiment over a simple experiment. **(A.U.A/M 2010, 2014)**
3. Compare one-way classification model with two-way classification model. **(A.U.N/D 2010)**
4. What is meant by Latin square? **(A.U.N/D 2010)**
5. What are the applications of *t*-distributions? **(A.U.A/M 2011)**
6. Write any two differences between RBD and CRD. **(A.U.A/M 2011)**
7. State the assumptions involved in ANOVA. **(A.U.M/J 2012)**
8. What are the advantages of a Latin square design? **(A.U.M/J 2012)**
9. State the basic principles of design of Experiments. **(A.U.N/D 2012), (A.U.M/J 2014,2015)**
10. Define :RBD **(A.U.N/D 2012)**
11. What do you understand by "Design of Experiments" ? **(A.U.A/M 2013)**

12. Write down the ANOVA table for one way classification. (A.U.A/M 2013)
13. What is the aim of design of Experiments. (A.U.N/D 2013)
14. Define 2² factorial design. (A.U.N/D 2013)
15. State any two advantages of a CRD. (A.U.M/J 2014)

PART – B

1. A set of data involving four “four tropical feed stuffs A, B, C, D” tried on 20 chicks is given below. All the twenty chicks are treated alike in all respects except the feeding treatments and each feeding treatment is given to 5 chicks. Analyze the data.

Weight gain of baby chicks fed on different feeding materials composed of tropical feed stuffs:

						Total T _i
A	55	49	42	21	52	219
B	61	112	30	89	63	355
C	42	97	81	95	92	407
D	169	137	169	85	154	714
	Grand Total					G=1695

(A.U.A/M 2010)

2. An experiment was planned to study the effect of sulphate of potash and super phosphate on the yield of potatoes. All the combinations of 2 levels of super phosphate and 2 levels of sulphate of potash were studied in a randomized block design with 4 replications for each. The yields (per plot) obtained are given below.

Block	Yields (lbs per plot)			
I	(1)	k	p	kp
	23	25	22	38
II	p	(1)	k	kp
	40	26	36	38
III	(1)	k	kp	p
	29	20	30	20
IV	kp	k	p	(1)
	34	31	24	28

(A.U.A/M 2010)

Analyze the data and comment on your findings. ($F(3,9) = 3.86$, $F(1, 9) = 5.12$).

3. Carry out ANOVA (Analysis of variance) for the following.

	A	B	C	D	
	1	44	38	47	36
	2	46	40	52	43
	3	34	36	44	32
	4	43	38	46	33
	5	38	42	49	39

Workers (A.U.N/D 2010)

4. Perform Latine Square Experiment for the following. (A.U.N/D 2010)

Roam	I	II	III → Three equally spaced concentrations of poison as extracted from the scorpion fish.
Arabic	1	2	3 → Three equally spaced body weights for the animals tested.
Latin	A	B	C → Three equally spaced times of storage of the poison before it is administered to the animals.

	I	II	III
1.	0.194	0.73	1.187
	A	B	C
2.	0.758	0.311	0.589
	C	A	B
3.	0.369	0.558	0.311
	B	C	A

5. The following are the number of mistakes made in 5 successive days by 4 technicians working for a photographic laboratory test at a level of significance $\alpha=0.01$. Test whether the difference among the four sample means can be attributed to chance. (A.U.A/M 2011)

	Technician			
	I	II	III	IV
6	14	10	9	
14	9	12	12	
10	12	7	8	
8	10	15	10	
11	14	11	11	

6. The following data represent the number of units of production per day turned out by 5 different workers using 4 different types of machines : (A.U.N/D 2011) (A.U.A/M 2013)

		Machine type			
		A	B	C	D
Workers	1	44	38	47	36
	2	46	40	52	43
	3	34	36	44	32
	4	43	38	46	33
	5	38	42	49	39

- (a) Test whether the mean production is the same for the different machine type.
- (b) Test whether the 5 mean differ with mean productivity.

7. A variable trial was conducted on wheat with 4 varieties in a Latin square design. The plan of the experiment and the per plot yield are given below. (A.U.N/D 2011)

C25	B23	A20	D20
A19	D19	C21	B18
B19	A14	D17	C20
D17	C20	B21	A15

8. The sales of 4 salesmen in 3 seasons are tabulated here. Carry out on analysis of variance.

	Salesmen			
Seasons	A	B	C	D
Summer	36	36	21	35
Winter	28	29	31	32
Monsoon	26	28	29	29

(A.U.N/D 2012)

9. A farmer wishes to test the effect of 4 fertilizers A,B,C,D on the yield of wheat. The fertilizers are used in a LSD and the result are tabulated here. Perform an analysis of variance. (A.U.N/D 2012)

A18	C21	D25	B11
D22	B12	A15	C19
B15	A20	C23	D24
C22	D21	B10	A14

10. Compare and contrast the Latin square design with the RBD. (A.U.A/M 2013)

11. Analyse the following of Latin square experiment.

Column	Row	1	2	3	4
1	A(12)	D(20)	C(16)	B(10)	
2	D(18)	A(14)	B(11)	C(14)	
3	B(12)	C(15)	D(19)	A(13)	
4	C(16)	B(11)	A(15)	D(20)	

(A.U.A/M 2013)

12. The following is a Latin square of a design when 4 varieties of seeds are being tested. Set up the analysis of variance table and state your conclusion. You may carry out suitable change of origin and scale.

A	105	B	95	C	125	D	115
C	115	D	125	A	105	B	105
D	115	C	95	B	105	A	115
B	95	A	135	D	95	C	115

(A.U.A/M 2013)

13. The following is a Latin square of a design when 4 varieties of seed are being tested. Set up the analysis of variance table and state your conclusion. You can carry out the suitable charge of origin and scale. (A.U.N/D 2013)

A	110	B	100	C	130	D	120
C	120	D	130	A	110	B	110
D	120	C	100	B	110	A	120
B	100	A	140	D	100	C	120

14. Analyse the following RBD and find your conclusion. (A.U.N/D 2013)

		Treatments			
		T ₁	T ₂	T ₃	T ₄
Blocks	B ₁	12	14	20	22
	B ₂	17	27	19	15
	B ₃	15	14	17	12
	B ₄	18	16	22	12
	B ₅	19	15	20	14

15. Four varieties A,B,C and D of a fertilizer are tested in a RBD with four replications.

The plot yields in pounds are as follows.

Column	Row	1	2	3	4
1	A(12)	D(20)	C(16)	B(10)	
2	D(18)	A(14)	B(11)	C(14)	
3	B(12)	C(15)	D(19)	A(13)	
4	C(16)	B(11)	A(15)	D(20)	

Analyse the experimental yield. (A.U A/M 2014)

16. Analyse the variance in the Latin square of yields(in kgs) of paddy where P,Q,R,S denote the different methods of cultivation.

S122	P121	R123	Q122
Q124	R123	P122	S125
P120	Q119	S120	R121
R122	S123	Q121	P121

Examine whether different method of cultivation have significantly different yields. (A.U A/M 2014)

UNIT III
SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS
PART - A

1. Using Newton-Raphson method, find the iteration formula to compute \sqrt{N} . (A.U.A/M 2010)
2. Explain the power method to determine the eigenvalue of a matrix. (A.U.A/M 2010)
3. Write the convergence condition and order of convergence for Newton-Raphson method.
(A.U.N/D 2010) (A.U A/M 2014)
4. Compare Gauss Jacobi with Gauss Jordan. (A.U.N/D 2010)
5. What is the order of convergence and also state the error term for Newton Raphson method?
(A.U.A/M 2011)
6. Find the dominant eigenvalue of the matrix $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ by power method. (A.U.A/M 2011)
7. Arrive a formula to find the value of $\sqrt[3]{N}$, where $N \neq 0$, using Newton-Raphson method.
(A.U.M/J 2011)
8. Solve the following system of equations using Gauss-Jordan elimination method
 $2x + y = 3, x - 2y = -1$. (A.U.M/J 2012)
9. Compare Gauss elimination and Gauss Jacobi methods. (A.U.N/D 2012)
10. Mention the order and condition for the convergence of Newton-Raphson method (A.U.N/D 2012)
11. Find the positive real root of $3x - \cos x - 1$ by N-R method correct to 6 decimal places.
(A.U.A/M 2013)
12. Solve the equations $A + B + C = 6; 3A + 3B + 4C = 20, 2A + B + 3C = 13$ using Gauss elimination Method. (A.U.A/M 2013)
13. State the principle used in Gauss – Jordan method. (A.U.N/D 2013)
14. Solve : $x + y + z = 6, 3x + 3y + 4z = 20, 2x + y + 3z = 13$ using Gauss elimination method.
(A.U.N/D 2013)
15. Write the procedure involved in Gauss elimination method. (A.U A/M 2014)
16. Find the real root of the equation $x = e^{x^2}$, using N- R method. (A.U N/D 2014)
17. Write down the iterative formula of Gauss – Seidel method. (A.U N/D 2014)

PART – B

1. Solve by Newton's method, find the real root of $x \log_{10} X = 1.2$ correct to five decimal places.
(A.U N/D 2011) (A.U A/M 2014)
2. Find the largest eigen values and its corresponding vector of the matrix (A.U N/D 2011)

$$A = \begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 6 \end{bmatrix} \text{ by power method.}$$

3. Solve by Gauss-seidel iterative procedure the system $8x - 3y - 2z = 20; 6x + 3y + 12z = 35; 4x + 11y - z = 33$.
(A.U N/D 2011)

4. Solve by Gauss Jordan method, find the inverse of the matrix $\begin{bmatrix} 2 & 2 & 6 \\ 2 & 6 & -6 \\ 4 & -8 & -8 \end{bmatrix}$ (A.U N/D 2011)

5. Apply Gauss elimination method to find the solution of the following system :
 $x+y+z=9$: $2x - 3y + 4z=13$: $3x + 4y+5z=40$. (A.U.N/D 2012)
6. Find the dominant eigen value of $\begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$ by power method. (A.U.N/D 2012)
7. Solve by Gauss Jordan method, find the inverse of the matrix $\begin{bmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 1 & 4 & 9 \end{bmatrix}$ (A.U.N/D 2012)
8. Solve the following equations by Gauss-seidel method $x+y+54z=110$: $27x+6y-z=-85$: $6x + 15y+2z=72$.
 (A.U.N/D 2012)
9. Solve the system of equations by Gauss Jordan method $x + y + z + w = 1$, $2x - y + 2z - w = - 5$,
 $3x + 2y += 3z + 4w= 7$, $x - 2y - 3z + 2w = 5$. (A.U.A/M 2013)
10. Apply Gauss elimination method to find the solution of the following system :
 $2x- y+8z=13$: $3x + 4y + 5z=18$: $5x - 2y+7z=20$. (A.U.A/M 2013)
11. Solve by Gauss-seidel iterative procedure the system $28x+4y-z=32$: $x+3y+10z=24$: $2x+17y+4z=35$
 (A.U.A/M 2013)
12. Find all the eigen value of $\begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$ by using Power method. (A.U.A/M 2013,N/D 2014)
13. Find a positive root for the equation $3x - \cos x = 1$ by N-R method. (A.U.N/D 2013)
14. Find the inverse of the matrix $\begin{bmatrix} 2 & 1 & 2 \\ 2 & 2 & 1 \\ 1 & 2 & 2 \end{bmatrix}$ by Gauss Jordan method. (A.U.N/D 2013)
15. Find the largest eigen value of the matrix $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & 0 \\ 0 & -1 & 0 \end{bmatrix}$ by power method .Also find its
 corresponding eigen vector. (A.U.N/D 2013)
16. Find the inverse of the matrix $\begin{bmatrix} 2 & 1 & 1 \\ 1 & 0 & -1 \\ 2 & -1 & 2 \end{bmatrix}$ by Gauss Jordan method. (A.U A/M 2014)
17. Solve by Gauss-seidel iterative procedure the system - $10x+2y+2z=4$: $x- 10y+2z=18$:
 $x+y - 10z=45$ (A.U A/M 2014)
18. Find the largest eigen value of the matrix $\begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix}$ by power method. (A.U A/M 2014)
19. Find the inverse of the matrix $\begin{bmatrix} 1 & -1 & 1 \\ 1 & 2 & 4 \\ 1 & 2 & 2 \end{bmatrix}$ by Gauss Jordan method. (A.U N/D 2014)
20. Find the solution , to three decimals, of the system using Gauss-seidel method
 $8x + 11y - 4z = 95$, $7x + 52y + 13z = 104$, $3x + 8y + 29z = 71$. (A.U N/D 2014)

UNIT IV
INTERPOLATION, NUMERICAL DIFFERENTIATION AND
NUMERICAL INTEGRATION
PART - A

- 1.State the properties of divided differences. (A.U N/D 2011) (A.U A/M 2014)
2. Show that $\Delta_{bcd}^3 \left(\frac{1}{a}\right) = \frac{-1}{abcd}$. (A.U N/D 2011)
3. What is need of Newton's and Lagrange's interpolation formula? (A.U.N/D 2012)
- 4.Find the area under the curve passing through the points (0,0),(1,2),(2,2.5),(3, 2.3),(4,2),(5,1.7)
 and (6, 1.5) . (A.U.N/D 2012)

5. Show that the divided difference of second order can be expressed as the quotient of two determinants of third order. (A.U.A/M 2013)
6. Use Lagrange's formula to fit a polynomial to the data and find y at x = 1.
- | | | | | |
|---|----|---|---|----|
| X | -1 | 0 | 2 | 3 |
| Y | -8 | 3 | 1 | 12 |
- (A.U.A/M 2013)
7. State the use of Lagrange's interpolation form. (A.U.N/D 2013) (A.U N/D 2014)
8. Evaluate $\int_1^2 \frac{1}{1+x^2} dx$, using Trapezoidal rule, taking h = 0.5. (A.U.N/D 2013)
9. What is 'inverse interpolation'? (A.U A/M 2014)
10. State Newton's forward and backward interpolating formula. (A.U N/D 2014)

PART – B

1. Using Lagrange's interpolation formula find y(10) given that y(5) = 12, y(6) = 13, y(9) = 14 and y(11) = 16. (A.U N/D 2011)
2. Evaluate $\int_0^{\frac{\pi}{2}} \sin x dx$ by using (i) Trapezoidal rule (ii) Simpson's rule taking 11 ordinates. (A.U N/D 2011)
3. Find the rate of growth of the population in 1931 using Newton's interpolation formula. (A.U N/D 2011)

Year	1931	1941	1951	1961	1971
Population	40.62	60.8	79.95	103.56	132.65

(A.U.N/D 2013)

4. Using Newton's backward interpolation formula find a polynomial of degree 3 passes through (3,0),(4,24),(5,60)and(6,120). (A.U N/D 2011)

5. Find y(22) given that (A.U.N/D 2012)

X :	20	25	30	35	40	45
Y(x):	354	332	291	260	231	204

6. Evaluate $\int_0^{\pi} \sin x dx$ by trapezoidal rule and Simpson's rule by dividing into 10 equal parts.

(A.U.N/D 2012) (A.U.N/D 2013)

7. Find y'(1), if

X :	0	2	3	4	7	9
Y(x):	4	26	58	112	466	922

(A.U.N/D 2012)

8. Using Newton's divided difference formula, find the value of f(2), f(8) and f(15) given the following table

x :	4	5	7	10	11	13
f(x):	48	100	294	900	1210	2928

(A.U.A/M 2013) (A.U.N/D 2013)

9. Using Lagrange's method, find the value of $f(3)$ from the following table.

x:	0	1	2	3	
y:	2	3	12	147	(A.U.N/D 2013)

10. Evaluate $I = \int_0^1 \int_0^1 \frac{dx dy}{1+x+y}$ by using Trapezoidal rule. (A.U.N/D 2013)

11. Find the polynomial $f(x)$ by using Lagrange's formula and hence find $f(4)$ for

x:	1	3	5	7	
f(x):	24	120	336	720	(A.U A/M 2014)

12. Evaluate $\int_0^1 \frac{1}{1+x} dx$ by using Simpson's one-third rule. (A.U A/M 2014)

13. Construct Newton's forward interpolation polynomial for the following data

x :	1	2	3	4	5	(A.U A/M 2014)
y :	1	-1	1	-1	1	and hence find $f(3.5), f''(3.5)$

14. The velocity v of a particle at a distance s from a point on its path is given as follows:

S in meter :	0	10	20	30	40	50	60	
V m/sec :	47	58	64	65	61	52	38	(A.U A/M 2014)

Estimate the time taken to travel 60 meters by using Trapezoidal rule and Simpson's 3/8 rule.

15. Find the first and second derivatives of $f(x)$ at $x = 1.5$ if (A.U N/D 2014)

x:	1.5	2.0	2.5	3.0	3.5	4.0
f(x):	3.375	7.000	13.625	24.000	38.875	59.000

UNIT V

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

PART - A

1. State Modified Euler algorithm to solve $y' = f(x, y), y(x_0) = y_0$ at $x = x_0 + h$. (A.U.N/D 2011, 2012, M/J 2013)
2. State the disadvantage of Taylor series method. (A.U N/D 2009, M/J 2012, 2014)
3. Write the merits and demerits of the Taylor method of solution. (A.U.N/D 2010, M/J 2012)
4. Which is better Taylor's method or R. K. Method? (or) State the special advantage of Runge-Kutta method over Taylor series method (A.U M/J 2011)
5. Compare Runge-Kutta methods and predictor-corrector methods for solution of initial value problem. (A.U M/J 2011)
6. What is a Predictor-corrector method of solving a differential equation? (A.U M/J 2009)

7. State the third order R.K method algorithm to find the numerical solution of the first order differential equation. (A.U M/J 2011,N/D 2012)
8. Write Milne's predictor formula and Milne's corrector formula. (A.U M/J 2012,N/D 2014)
9. Write down Adams-bashforth Predictor and Adams-bashforth corrector formula.
10. State Euler formula (A.U M/J 2013)
11. Write down finite difference formula for $y'(x)$ and $y''(x)$ (A.U M/J 2012,N/D 2014)

PART - B

1. Using Taylor's series method find y at $x = 0.1$ if $\frac{dy}{dx} = x^2y - 1, y(0) = 1$. (A.U N/D 2010,N/D 2014)
2. Solve: $y' = x + y$; $y(0) = 1$, by Taylor's series method. Find the values y at $x = 0.1$ and $x = 0.2$ (A.U M/J 2010,M/J 2013)
3. Using Taylor's series method find $y(1.1)$ given $y' = x + y, y(1) = 0$ (A.U M/J 2011,2012,M/J 2013)
4. Using Euler's method find $y(0.2)$ and $y(0.4)$ from $y' = x + y, y(0) = 1$ with $h = 0.2$ (A.U M/J 2010,2011,M/J 2012)
5. Consider the initial value problem $y' = y - x^2 + 1, y(0) = 0.5$ using the modified Euler's method, find $y(0.2)$ (A.U N/D 2013,N/D 2014)
6. Using R.K method of fourth order, Solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with $y(0) = 1$ at $x = 0.2$. (A.U M/J 2010,2011,M/J 2012)
7. Using Milne's method find $y(4.4)$ given $5xy' + y^2 - 2 = 0$ given $y(4) = 1, y(4.1) = 1.0049, y(4.2) = 1.0097$ and $y(4.3) = 1.0143$. (A.U N/D 2010,N/D 2014)

STUCOR APP

MA8452

STATISTICS AND NUMERICAL METHODS

TWO MARK QUESTION AND ANSWERS

UNIT I
TESTING HYPOTHESIS

1. Mention the various steps involved in testing of hypothesis. (A.U.A/M 2010)

Solution:

- (i) Set up a null hypothesis H_0 .
- (ii) Set up the alternative hypothesis H_1 .
- (iii) Select the appropriate level of significance (α).
- (iv) Compute the test statistic $z = \frac{t - E(t)}{sE(t)}$ under H_0
- (v) We compare the “calculate z” with “critical value z_α ” at given level of significance (α).

2. Define Chi-Square test for goodness of fit. (A.U.A/M 2010)

Solution:

Chi-Square test of goodness of fit is a test to find if the deviation of the experiment from theory is just by chance or it is due to the inadequacy of the theory to fit the observed data. By this test, we test whether difference between observed and expected frequencies are significant or not.

Chi-Square test statistic of goodness of fit is defined by $\chi^2 = \sum \frac{(O-E)^2}{E}$, where O is the observed frequency and E expected frequency.

3. What are the parameters and statistics in sampling? (A.U.N/D 2010, 2011)

Solution:

- Parameters : μ - mean, σ - standard deviation of population
 Statistics : \bar{x} - mean, s - standard deviation of sample.

4. Write two applications of χ^2 -test. (A.U.N/D 2010, M/J 2012)

Solution:

- (i) To test the goodness of fit
- (ii) To test the independent of attributes
- (iii) To test the homogeneous of independent estimations

5. What are the applications of t -distributions? (A.U.A/M 2011)

Solution:

- (i) To test the significance of a single mean.
- (ii) To test the significance of the difference between two sample means.
- (iii) To test the significance of the coefficient of correlation.

6. Define Type I and Type II errors in taking a decision. (A.U.A/M 2011, M/J 2012, N/D 2013, M/J 2014)

Solution:

- Type I error : Reject H_0 when it is true.
 Type II error : Accept H_0 when it is wrong.
 (i.e) accept H_0 and H_1 is true.

7. Define Null and Alternate Hypothesis. (A.U. M/J 2012)

Solution:

For applying the test of significance, we first set up of a hypothesis a definite statement about the population parameter. Such a hypothesis is usually a hypothesis of no difference and it is denoted by H_0 .

Any hypothesis which is complementary to the null hypothesis (H_0) is called an alternative hypothesis, denoted by H_1 .

8. Define Level of significance. (A.U M/J 2011,A.U.N/D 2013)

Solution:

The probability that the value of the statistic lies in the critical region is called the level of significance.

In general, these levels are chosen as 0.01 and 0.05, called 1% level and 5% level of significance respectively.

9. State the conditions for applying χ^2 –test . (A.U.M/J 2014)

Solution:

- (i) The sample observations should be independent.
- (ii) Constraints on the cell frequencies, if any, must be linear.
- (iii) N, the total frequency, should be at least 50.
- (iv) No theoretical cell frequency should be less than 50.

a	b
c	d

10. Give the formula for the χ^2 –test of independence for (A.U.N/D 2012,N/D2014)

Solution:

Formula is
$$\frac{(a+b+c+d)(ad-bc)^2}{(a+c)(b+d)(a+b)(c+d)}$$

11. The heights of college students in Chennai are normally distributed with S.D 6cm and sample of 100 students had their mean height 158cm. Test the hypothesis that the mean height of college students in Chennai is 160cm at 1% level of significance. (A.U.N/D 2011)

Solution:

$H_0 : \mu = 160 ; H_1 : \mu \neq 160$

$$z = \frac{x-\mu}{\frac{\sigma}{\sqrt{n}}} = \frac{158-160}{\frac{6}{\sqrt{100}}} = - 3.33 > 2.58$$

H_0 is rejected.

12. Define Error. (A.U.N/D 2009)

Solution:

In sampling theory to draw valid inferences about the population parameter on the basis of the sample results we decide to accept or to reject the H_0 after examining a sample from it.

Type I error : Reject H_0 when it is true.

Type II error : Accept H_0 when it is wrong.

UNIT II
DESIGN OF EXPERIMENTS

1. Discuss the advantages and disadvantages of Randomized block design. (A.U.A/M 2010)

Solution:

Advantage:

- (i) Analysis is possible, even if some observations are missing.
- (ii) The analysis of the design is simple as it results in a two-way classification analysis of variance.

Disadvantage:

- (i) If the interactions are large, the experiment may yield misleading results.
- (ii) The shape of the experimental material should be rectangular.

2. State the advantages of a factorial Experiment over a simple experiment. (A.U.A/M 2010, 2014)

Solution:

Factorial experiment is the procedure of varying all factors simultaneously.

A major conceptual advancement in experimental design is exemplified by factorial design. In factorial designs, an assessment of each individual factor effect is based on the whole set of measurements so that a more efficient utilization of experimental resources is achieved in these designs.

3. Compare one-way classification model with two-way classification model. (A.U.N/D 2010, 2011)

Solution:

	One way classification	Two way classification
1.	One factor is involved	Two factors involved
2.	One set of hypothesis	Two set of hypothesis

4. What is meant by Latin square? (A.U.N/D 2010)

Solution:

The Latin Square model assumes that interactions between treatments and row and column groupings non-existent. Since each treatment occurs only once in each row or column, if interactions are present, it is possible for them to cause an apparently significant difference between treatment.

5. What are the applications of t -distributions? (A.U.A/M 2011)

Solution:

- (i) To test the significance of a single mean.
- (ii) To test the significance of the difference between two sample means.
- (iii) To test the significance of the coefficient of correlation.

6. State the assumptions involved in ANOVA. (A.U.M/J 2012)

Solution:

- 1. Normality
- 2. Homogeneity
- 3. Independence of error.

7. What are the advantages of a Latin square design? (A.U.M/J 2012)

Solution:

- (i) The analysis is simple, it is only slightly more complicated than that for the randomized complete block design.
- (ii) The analysis remains relatively simple even with missing data. Analytical procedures are available for omitting one or more treatment, rows or columns.

8. State the basic principles of design of Experiments. (A.U.N/D 2012), (A.U.M/J 2014)

Solution:

The basic principles of the design of experiments are

- (i) Replication (ii) Randomization (iii) Local control.

9. Define :RBD (A.U.N/D 2012)

Solution:

Let us consider an agricultural experiment using which we wish to test the effect of ‘k’ fertilising treatment on the yield of crops. We assume that we know some information about the soil fertility of the plots. Then we divide the plots into ‘h’ blocks, according to the soil fertility each block containing ‘k’ blocks. Thus the plots in each block will be of homogeneous fertility as far as possible within each block, the ‘k’ treatments are given to the ‘k’ plots in a perfectly random manner, such that each treatment occurs only once in any block. But the same k treatment are from block to block. This design is called **Randomized Block Design**.

10. What do you understand by “Design of Experiments”? (A.U.A/M 2013)

Solution:

The design of experiment may be defined as the logical construction of the experiment in which the degree of uncertainty with which the inference is drawn may be well defined.

11. Write down the ANOVA table for one way classification. (A.U.A/M 2013)

Solution:

Source of Variation	SS(Sum of Squares)	Degree of Freedom	Mean Square	Variance Ratio of F
Between Sample	SSC	$V_1 = c - 1$	$MSC = \frac{SSC}{(c-1)}$	$F_C = \frac{MSC}{MSE}$
Within Sample	SSE	$V_2 = n - c$	$MSE = \frac{SSE}{(n-c)}$	
Total	TSS	n- 1		

12. Define 2^2 factorial design.

(A.U.N/D 2013)

Solution:

A complete replicate of such a design requires $2 \times 2 \times \dots \times 2 = 2^k$ observations is called a 2^k factorial design.

2^2 is the simplest design 2^k .

i.e., Two factors A and B each at two level that it may be low and high levels of the factor.

13. State any two advantages of a CRD .

(A.U.M/J 2014)

Solution:

- (i) It has a simple lay out.
- (ii) There is complete flexibility as the number of replication is not fixed.
- (iii) Analysis can be performed, if some observation are missing.

UNIT III

SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS

1. What is the order of convergence of Newton-Raphson methods if the multiplicity of the root is one.

Solution:

(A.U M/J 2009) (A.U M/J 2010)

Order of convergence of N.R method is 2

2. What is the rate of convergence in N.R method?

(A.U M/J 2011) (A.U M/J 2009)

Solution:

The rate of convergence in N.R method is of order 2

3. Define round off error.

(A.U M/J 2010)

Solution:

The round off error is the quantity R which must be added to the finite representation of a computed number in order to make it the true representation of that number.

4. State the principle used in Gauss-Jordan method.

(A.U M/J 2012)

Solution:

Coefficient matrix is transformed into diagonal matrix.

5. Compare Gaussian elimination method and Gauss- Jordan method.

(A.U M/J 2009)

Solution:

	Gaussian elimination method	Gauss- Jordan method
1	Coefficient matrix is transformed into upper triangular matrix	Coefficient matrix is transformed into diagonal matrix
2	Direct method	Direct method
3	We obtain the solution by back substitution method	No need of back substitution method

6. Determine the largest eigen value and the corresponding eigen value vector of the matrix $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ correct to two decimal places using power method. (A.U M/J 2012)

Solution:

$$AX_1 = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 2 \\ 2 \end{pmatrix} = 2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} = 2X_2$$

$$AX_2 = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 2 \\ 2 \end{pmatrix} = 2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} = 2X_3$$

This shows that the largest eigen value = 2, The corresponding eigen value = $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$

7. Write the Descartes rule of signs.

(A.U M/J 2011)

Solution:

1) An equation $f(x) = 0$ cannot have more number of positive roots than there are changes of sign in the terms of the polynomial $f(x)$.

2) An equation $f(x) = 0$ cannot have more number of positive roots than there are changes of sign in the terms of the polynomial $f(x)$.

8. Write a sufficient condition for Gauss sieidel method to converge .(or)

State a sufficient condition for Gauss Jacobi method to converge.

(A.U M/J 2010)

Solution:

The process of iteration by Gauss sieidel method will converge if in each equation of the system the absolute value of the largest coefficient is greater than the sum of the absolute values of the remaining coefficients.

9. State the order of convergence and convergence condition for NR method

Solution:

(A.U M/J 2009)

The order of convergence is 2

$$\text{Condition of convergence is } |f(x)f''(x)| < |f'(x)|^2$$

10. Compare Gauss Siedel and Gauss elimination method?

(A.U M/J 2012)

Solution:

	Guass Jacobi method	Guass siedel method
1.	Convergence method is slow	The rate of convergence of Guass Siedel method is roughly twicethat of Guass Jacobi.
2.	Direct method	Indirect method
3.	Condition for convergence is the coefficient matrix diagonally dominant	Condition for convergence is the coefficient matrix diagonally dominant

11. Is the iteration method a self correcting method always?

(A.U M/J 2011)

Solution:

In general iteration is a self correcting method since the round off error is smaller.

12. If $g(x)$ is continuous in $[a, b]$ then under what condition the iterative method $x = g(x)$ has a unique solution in $[a, b]$.

(A.U M/J 2010)

Solution:

Let $x = r$ be a root of $x = g(x)$. Let $I = [a, b]$ be the given interval combining the point $x = r$. if $|g'(x)| < 1$ for all x in I , the sequence of approximation x_0, x_1, \dots, x_n will converge to the root r , provided that the initial approximation x_0 is chosen in I .

13. When would we not use N-R method .

(A.U M/J 2012)

Solution:

If x_1 is the exact root and x_0 is its approximate value of the equation $f(x) = 0$. we know that $x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$
 If $f'(x_0)$ is small, the error $\frac{f(x_0)}{f'(x_0)}$ will be large and the computation of the root by this method will be a slow process or may even be impossible.
 Hence the method should not be used in cases where the graph of the function when it crosses the x axis is nearly horizontal.

14. Write the iterative formula of NR method.

(A.U M/J 2010)

Solution:

$$X_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}, \quad n = 0, 1, 2, \dots$$

UNIT IV

INTERPOLATION, NUMERICAL DIFFERENTIATION AND
NUMERICAL INTEGRATION

1. What is the assumption we make when Lagrange's formula is used? (A.U M/J 2012)

Solution:

Lagrange's interpolation formula can be used whether the values of x , the independent variable are equally spaced or not whether the difference of y become smaller or not.

2. When Newton's backward interpolation formula is used. (A.U M/J 2009)

Solution:

The formula is used mainly to interpolate the values of y near the end of a set of tabular values and also for extrapolation the values of y a short distance ahead of y_0

3. What are the errors in Trapezoidal rule of numerical integration? (A.U M/J 2011)

Solution:

The error in the Trapezoidal rule is

$$E < \frac{(b-a)h^2}{12} y''(\xi)$$

4. Why Simpson's one third rule is called a closed formula? (A.U M/J 2012)

Solution:

Since the end point ordinates y_0 and y_n are included in the Simpson's 1/3 rule, it is called closed formula.

5. What are the advantages of Lagrange's formula over Newton's formula

(A.U M/J 2009)

Solution:

The forward and backward interpolation formulae of Newton can be used only when the values of the independent variable x are equally spaced and can also be used when the differences of the dependent variable y become smaller ultimately. But Lagrange's interpolation formula can be used whether the values of x , the independent variable are equally spaced or not and whether the difference of y become smaller or not.

6. When do we apply Lagrange's interpolation? (A.U M/J 2013)

Solution:

Lagrange's interpolation formula can be used when the values of " x " are equally spaced or not. It is mainly used when the values are unevenly spaced.

7. What are the disadvantages in practice in applying Lagrange's interpolation formula?

Solution:

(A.U N/D 2010)

1. It takes time.
2. It is laborious

8. When Newton’s backward interpolation formula is used. (A.U M/J 2010)

Solution:

The formula is used mainly to interpolate the values of ‘y’ near the end of a set of tabular values.

9. When Newton’s forward interpolation formula is used. (A.U M/J 2011)

Solution:

The formula is used mainly to interpolate the values of ‘y’ near the beginning of a set of tabular values.

10. When do we use Newton’s divided differences formula? (A.U M/J 2009)

Solution:

This is used when the data are unequally spaced.

11. Write Forward difference operator. (A.U M/J 2009) (A.U M/J 2012)

Solution:

Let $y = f(x)$ be a function of x and let $y_0, y_1, y_2, \dots, y_n$ of the values of y corresponding to $x_0, x_0 + h, x_0 + 2h, \dots$ of the values of x . Here, the independent variable (or argument), x proceeds at equally spaced intervals and h (constant), the difference between two consecutive values of x is called the interval of differencing. Now the forward difference operator is defined as

$$\begin{aligned} \Delta y_0 &= y_1 - y_0 \\ \Delta y_1 &= y_2 - y_1 \\ &\dots\dots\dots \\ \Delta y_n &= y_{n+1} - y_n \end{aligned}$$

These are called first differences.

12. Write Backward difference operator. (A.U N/D 2009)

Solution:

The backward difference operator ∇ is defined as

$$\begin{aligned} \nabla y_n &= y_n - y_{n+1} \\ \text{For } n=0,1,2 \dots \\ y_0 &= y_0 - y_{-1} \\ \nabla y_1 &= y_1 - y_0 \\ \nabla y_2 &= y_2 - y_1 \\ &\dots\dots\dots \end{aligned}$$

These are called first differences

UNIT V

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

1. State Modified Euler algorithm to solve $y'=f(x,y), y(x_0)=y_0$ at $x=x_0 + h$. (A.U.N/D 2011,2012, M/J 2013)

Solution:

$$\begin{aligned} y_{n+1} &= y_n + hf \left[x_n + \frac{h}{2} y_n + \frac{h}{2} f(x_n, y_n) \right] \\ y_1 &= y_0 + hf \left[x_0 + \frac{h}{2} y_0 + \frac{h}{2} f(x_0, y_0) \right] \end{aligned}$$

2. State the disadvantage of Taylor series method. (A.U N/D 2009,M/J 2012,2014)

Solution:

In the differential equation $f(x, y), \frac{dy}{dx} = f(x, y)$, the function $f(x, y)$, may have a complicated algebraical structure. Then the evaluation of higher order derivatives may become tedious. This is the demerit of this method.

3. Write the merits and demerits of the Taylor method of solution. (A.U.N/D 2010, M/J 2012)

Solution:

The method gives a straight forward adaptation of classic to develop the solution as an infinite series. It is a powerful single step method if we are able to find the successive derivatives easily. If $f(x, y)$ involves some complicated algebraic structures then the calculation of higher derivatives becomes tedious and the method fails. This is the major drawback of this method. However the method will be very useful for finding the starting values for powerful methods like Runge - Kutta method, Milne's method etc.

4. Which is better Taylor's method or R. K. Method?(or) State the special advantage of Runge-Kutta method over Taylor series method (A.U M/J 2011)

Solution:

R.K Methods do not require prior calculation of higher derivatives of $y(x)$, as the Taylor method does. Since the differential equations used in applications are often complicated, the calculation of derivatives may be difficult.

Also the R.K formulas involve the computation of $f(x, y)$ at various positions, instead of derivatives and this function occurs in the given equation.

5. Compare Runge-Kutta methods and predictor – corrector methods for solution of initial value problem. (A.U M/J 2011)

Solution: Runge-Kutta methods

1. Runge-methods are self starting, since they do not use information from previously calculated points.
2. As methods are self starting, an easy change in the step size can be made at any stage.
3. Since these methods require several evaluations of the function $f(x, y)$, they are time consuming.
4. In these methods, it is not possible to get any information about truncation error.

Predictor Corrector methods:

1. These methods require information about prior points and so they are not self starting.
2. In these methods it is not possible to get easily a good estimate of the truncation error.

6. What is a Predictor-corrector method of solving a differential equation? (A.U M/J 2009)

Solution:

Predictor-corrector methods are methods which require the values of y at $x_n, x_{n-1}, x_{n-2}, \dots$ for computing the value of y at x_{n+1} . We first use a formula to find the value of y at x_{n+1} and this is known as a predictor formula. The value of y so got is improved or corrected by another formula known as corrector formula.

7. State the third order R.K method algorithm to find the numerical solution of the first order differential equation. (A.U M/J 2011,N/D 2012)

Solution:

To solve the differential equation $y' = f(x, y)$ by the third order R.K method, we use the following algorithm.

$$\begin{aligned} k_1 &= hf(x, y) \\ k_2 &= hf\left(x + \frac{h}{2}, y + \frac{k_1}{2}\right) \\ k_3 &= hf(x + h, y + 2k_2 - k_1) \\ \text{and } \Delta y &= \frac{1}{6}(k_1 + 4k_2 + k_3) \end{aligned}$$

8. Write Milne's predictor formula and Milne's corrector formula. (A.U M/J 2012,N/D 2014)

Solution:

Milne's predictor formula is

$$y_{4,p} = y_0 + \frac{4h}{3}[2y'_1 - y'_2 + 2y'_3]$$

Milne's corrector formula is

$$y_{4,c} = y_2 + \frac{h}{3}[y'_2 + 4y'_3 + y'_4]$$

9. Write down Adams-bashforth Predictor and Adams-bashforth corrector formula.

Solution:

(A.U N/D 2011)

Adams-bashforth predictor formula is

$$y_{4,p} = y_3 + \frac{h}{24}[55y'_3 - 59y'_2 + 37y'_1 - 9y'_0]$$

Adams -bashforth corrector formula is

$$y_{4,c} = y_3 + \frac{h}{24}[9y'_4 + 19y'_3 - 5y'_2 + y'_1]$$

10. State Euler formula

(A.U M/J 2013)

Solution:

$$y_{n+1} = y_n + hf[x_n, y_n] \text{ when } n = 0, 1, 2, \dots$$

11. Write down finite difference formula for $y'(x)$ and $y''(x)$ (A.U M/J 2012,N/D 2014)

Solution:

$$y'(x) = \frac{y_{i+1} - y_i}{h}, \quad y''(x) = \frac{y_{i-1} - 2y_i + y_{i+1}}{h^2}$$