D 92501 (Pages : 4) Name..............................

Reg. No..............................

FIFTH SEMESTER U.G. DEGREE [SPECIAL] EXAMINATION NOVEMBER 2020

(CUCBCSS—UG)

Statistics

STS 5B 05—MATHEMATICAL METHODS IN STATISTICS

Time : Three Hours Maximum : 80 Marks

Section A

Answer **all** *questions.*
Each question carries 1 *mark.*

Name the following :

1. If a function is increasing function then $-f$ is : ————————.

2. If $f:[a, b] \rightarrow R$, P and Q are partitions of $[a, b]$ such that $P \subset Q$, then ————————.

3. The series $\sum_{n=1}^{\infty} (-1)^n$ is :

Fill up the blanks :

4. If a function f is bounded and continuous on $[a, b]$. There exist a number η in closed interval $[a, b]$ such that $\int_a^b f(x)\,dx =$ ————————.

5. The value of $\lim_{x \to -1} \frac{(x+2)(3x-1)}{x^2+3x-2}$ is ————————.

6. If $\lim_{n \to \infty} S_n = l$ then $\lim_{n \to \infty} \frac{S_1 + S_2 + ... + S_n}{n} =$ ————————.

7. If $\sum U_n$ converges and $\sum V_n$ diverges, then $\sum (U_n + V_n)$ is ————————.

Turn over

Write True *or* False :

8. Every convergent sequence has a unique limit.

9. Every constant function is continuous.

10. A function $f(x) = \frac{x^2 - 1}{x - 1}$ is not discontinuous at $x = 1$.

(10 × 1 = 10 marks)

Section B

*Answer **all** questions.*
Each question carries 2 marks.

11. State Cauchy's general principles of convergence.

12. State Rolle's theorem.

13. Test the convergence of $1 - \frac{1}{2\sqrt{2}} + \frac{1}{3\sqrt{3}} - \frac{1}{4\sqrt{4}} + \ldots$

14. State and prove Archimedean Property of Real numbers.

15. Show that $\lim_{n \to \infty} \frac{3 + 2\sqrt{n}}{\sqrt{n}} = 2$.

16. Define increasing and decreasing functions.

17. State Cauchy's Mean Value Theorem.

(7 × 2 = 14 marks)

Section C

*Answer at least **two** questions.*
Each question carries 6 marks.
All questions can be attended.
Overall Ceiling 12.

18. Show that the function $f(x) = x^2$ is derivable on $[0\ 1]$.

19. Find Left and Right limit of the following function :

$$f(x) = \begin{cases} \frac{x\left(e^{1/x} - 1\right)}{e^{1/x} + 1}, & x \neq 0 \\ 0, & x = 0 \end{cases}.$$

20. Show that $\frac{V-U}{1+V^2} < tan^{-1}V - tan^{-1}U < \frac{V-U}{1+U^2}$.

21. State and prove comparison test II.

22. If f is non-negative continuous function on $[a, b]$ such that $\int_a^b f(x)\,dx \geq 0$. Then show that $f(x) = 0 \;\forall\; x \in [a, b]$.

(2 × 6 = 12 marks)

Section D

Answer at least **three** *questions.*
Each question carries 8 *marks.*
All questions can be attended.
Overall Ceiling 24.

23. Show that a bounded and monotonic function is integrable on $[a, b]$.

24. Show that $\{r^n\}$ is convergent if $-1 \leq r \leq 1$.

25. Test the convergence of $\sum \frac{n^2 - 1}{n^2 + 1} x^n$.

26. Obtain the points of discontinuity of the function defined on $[0 \;\; 1]$ as follows

$$f(x) = \begin{cases} 0 & ; \quad x = 0 \\ \frac{1}{2} - x & ; \quad 0 < x < \frac{1}{2} \\ \frac{1}{2} & ; \quad x = \frac{1}{2} \\ \frac{3}{2} - x & ; \quad \frac{1}{2} < x < 1 \\ 1 & ; \quad x = 1 \end{cases}$$

27. Let $f(x) = x^3$ on $[0 \;\; k]$. Show that f is Riemann integrable and $\int_0^k f(x)\,dx = \frac{k^4}{4}$.

28. State and prove First Mean Value Theorem of integral Calculus.

(3 × 8 = 24 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

29. i) State and prove D'Alembert's Ratio test.

ii) Test convergence of $\frac{1}{1.2.3} + \frac{3}{2.3.4} + \frac{5}{3.4.5.} + ...$

30. Prove that a necessary and sufficient condition for a sequence to be convergent is that it is bounded and has a unique limit point.

31. Show that :

i) $f(x) = \sin x$ is uniformly continuous on $[0, \infty)$.

ii) $f(x) = x^2$ is not uniformly continuous on $[0, \infty)$.

32. If P* is a refinement of P, then show that :

(i) $L(P, f) \le L(P^*, f)$.

(ii) $U(P, f) \ge U(P^*, f)$.

(2 × 10 = 20 marks)

D 90274

(Pages : 2)

Name...

Reg. No.......................................

FIFTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CUCBCSS—UG)

Statistics

STS 5D 02—QUALITY CONTROL

Time : Two Hours

Maximum : 40 Marks

Use of calculator is permitted.

Part A

All questions to be attended.
Each question carries 1 mark.

1. The commonly used control chart to control the dispersion of quantitative variable is ————.
2. c chart is used to control ————.
3. The probability of accepting a lot of bad quality is called ————.
4. The quality level which the consumer regard as rejectable is called ————.
5. The expected value of sample size required for coming to a decision about the acceptance or rejection is called ————.

(5 × 1 = 5 marks)

Part B

All questions can be attended and overall ceiling.
Each question carries 2 marks.

6. What are the different parts of typical control chart ?
7. Define chance causes.
8. Define AQL.
9. What is the application of c chart ?
10. What do you understand by acceptance sampling ?

(5 × 2 = 10 marks)

Part C

All questions can be attended and overall ceiling.
Each question carries 5 marks.

11. Distinguish between process control and product control.
12. Explain the logic of setting the three sigma control limits.

Turn over

D 90273

(Pages : 2)

Name..............................

Reg. No..............................

FIFTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CUCBCSS—UG)

Statistics

STS 5D 01—ECONOMIC STATISTICS

Time : Two Hours

Maximum : 40 Marks

Part A

All questions to be attended.
Each question carries 1 mark.

1. A time series consists of at the most ———————— components.
2. Seasonal variations are the periodic and regular movements in a time series with period ————————.
3. Index numbers are known as ————————.
4. ———————— is theoretically considered as the best average for constructing index numbers
5. ———————— index numbers are computed to get a measure of the general price movement of the commodities consumed by different classes of people.

(5 × 1 = 5 marks)

Part B

All questions can be attended and overall ceiling.
Each question carries 2 marks.

6. Name four methods of measuring trend.
7. Explain secular trend.
8. What are the four different phases in a business cycle.
9. Explain time reversal test.
10. What is meant by deflating ?

(5 × 2 = 10 marks)

Turn over

Part C

All questions can be attended and overall ceiling.
Each question carries 5 marks.

11. Explain the uses of time series
12. Describe the moving average method of estimating trend to time series data.
13. Why index numbers are called economic barometers.
14. Show that Fisher's index number satisfies the factor reversal test
15. Discuss various steps involved in the construction of consumer price index

(3 × 5 = 15 marks)

Part D

All questions can be attended and overall ceiling.
The question carries 10 marks.

16. Fit a linear trend to the following data by the method of least squares. Also estimate the value for the year 1987 :

Year	1980	1981	1982	1983	1984	1985	1986
Profit	125.5	136.1	142.9	158.3	171.3	197.7	200.8

17. Calculate Laspayer's, Paasche's and Fisher's index numbers from the following data

Commodity	1994		1995	
	Price	Quantity	Price	Quantity
A	2	8	4	6
B	5	10	6	5
C	4	14	5	10
D	2	19	2	13

18. Explain the problems while constructing index numbers. Differentiate simple aggregate and weighted aggregate index numbers

(1 × 10 = 10 marks)

D 90272

(Pages : 3)

Name.......................................

Reg. No...................................

FIFTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CUCBCSS—UG)

Statistics

STS 5B 09—PRACTICAL—Paper I

Time : Three Hours | Maximum : 80 Marks

Use of Calculator and Statistical table is permitted.

Answer any **four** *questions.*
Each question carries 20 marks.

1. (a) From the following table test whether the colour of the sons eye is associated with that of fathers ?

Eye colour in sons / Eye color in fathers	black	Light brown	Total
black	230	148	378
Light brown	151	471	622
Total	381	619	1000

Test the hypothesis that colour of eyes of sons is independent that of fathers. Test at 5% level of significance.

(b) Two random samples drawn from two normal populations :

Sample I :	63	65	68	69	71	72				
Sample II :	63	62	65	66	69	69	70	71	72	73

Test whether the two populations have the same variance.

(10 + 10 = 20 marks)

2. (a) Samples of two types of electric light bulbs were tested for length of life and following details are obtained :

	Type I	Type II
Sample size	$n_1 = 8$	$n_2 = 7$
Sample Means	1234 hours	1036 hours
Sample S.D.'s	36 hours	40 hours

Is the difference in the means is sufficient to warrant that type I is superior to type II regarding length of life. Samples are taken from same normal population.

Turn over

(b) The scores of an IQ test of 10 students prior and after a training are given below :

Student	1	2	3	4	5	6	7	8	9	10
Prior the training	18	21	16	22	19	24	17	21	23	18
After the training	22	25	17	24	16	29	20	23	19	20

Test whether the training is effective or not.

(8 + 12 = 20 marks)

3. (a) The average wage of a sample of 1000 workers in a plant A was Rs. 250 with a S.D. of Rs. 150. The average wage of sample of 1500 workers in plant B was Rs. 268 with S.D. of Rs. 200. Can an applicant safely assume that the wage paid by Plant B is higher than those paid by plant A

(b) The CEO of large electric utility company claims that 80% of his 1000 costumers are very satisfied with service they receive. To test his claim, the local news paper surveyed 100 costumers, using simple random sampling. Among the sampled customers 73% say they are very satisfied. Test whether CEO's claim is true ?

(c) Ten individuals are chosen from a population and their heights are found to be 63, 63, 66, 67, 68, 69, 70, 70,71, 71 (inches). Does this sample suggest that the mean height of population is 66 inches ?

(6 + 6 + 8 = 20 marks)

4. (a) A random sample of 16 values from a normal population showed a mean of 41.5 inches and the sum of squares of deviations from this mean equal to 135 square inches. Obtain 95% confidence interval for the population mean μ.

(b) A random sample of size 10 from a normal distribution has sample variance 277. Obtain 95% confidence interval for the population variance.

(c) If the mean age at death of 64 men engaged in an occupation is 52.4 years with standard deviation of 10.2 years . Obtain 95 % confidence interval for the mean age of all men in that occupation.

(7 + 7 + 6 = 20 marks)

5. In a population of size N = 5, values of Y are 2, 4 , 6 , 8, 10. Select samples of size 3 :

(i) How many possible samples are there ?

(ii) Find the sample mean and variance.

(iii) Prove that sample mean and variance are unbiased estimate of population mean and variance.

(iv) Further show that variance of the estimate 'y' from SRS WOR is less than that obtained from SRS WR

6. (a) A co-efficient of correlation of 0.2 derived from a random sample of 625 pairs of observation, Is this value of r is significant ?

(b) In a large city A, 20% of a random sample of 900 school children had defective eye sight. In other large city B, 15% of random sample of 1600 children had the same effect. Is the difference between the two proportion is significant ?

(c) The following figures show the distribution of digits in numbers choosen at random from telephone directory :

Digits	0	1	2	3	4	5	6	7	8	9
Frequency	1026	1107	997	966	1075	933	1107	972	964	953

Examine whether digits are equally frequently ?

(5 + 5 + 10 = 20 marks)

D 90271 (Pages : 3) Name...

Reg. No....................................

FIFTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CUCBCSS—UG)

Statistics

STS 5B 08—OPERATIONS RESEARCH AND STATISTICAL QUALITY CONTROL

Time : Three Hours Maximum : 80 Marks

Section A

Answer **all** *questions.*
Each question carries 1 *mark.*

1. Development of control chart was made by ————.
2. In SQC, the product control is achieved through the technique of ————.
3. Abbreviation of LTPD ————.
4. ———— of a sampling plan is graphical representation of the relationship between the probability of acceptance and fraction defective in the lot.
5. Any instance or characteristic that does not have the specified level of quality is called ————.
6. In control chart, any point which lies outside the control limit is clear indication of ————.
7. The dual of the primal maximization linear programming problem should be ————.
8. An assignment problem in which the assignment matrix is not a square matrix is called ————.
9. ———— is a technique for determining an optimum schedule of interdependent activities in view of available resources.
10. The inequation of general LPP is called ————.

(10 × 1 = 10 marks)

Section B

Answer **all** *questions.*
Each question carries 2 *marks.*

11. Explain the procedure for mathematical formulation of linear programming problem.
12. Explain primal and dual problems with examples.
13. Define slack and surplus variables.

Turn over

14. What are the different parts of typical control chart ?

15. What are the uses of OC curve ?

16. State the advantages and limitations of statistical quality control.

17. What are rational subgroups ?

(7 × 2 = 14 marks)

Section C

Answer at least **two** *questions.*
Each question carries 6 *marks.*
All questions can be attended.
Overall Ceiling 12.

18. Explain the construction and working of c chart and lists the uses of c chart.

19. Describe Single sampling plan. Obtain OC curve for this plan.

20. Explain : a) LTPD b) AOQ c) Producer's risk d) ASN.

21. Explain Vogel's approximation method of solving a transportation problem.

22. Describe the general rules for writing the dual of a LPP.

(2 × 6 = 12 marks)

Section D

Answer at least **three** *questions.*
Each question carries 8 *marks.*
All questions can be attended.
Overall Ceiling 24.

23. What are natural tolerance limit and specification limit ? Explain about Modified control chart.

24. Explain the construction of p and np chart.

25. Describe the double sampling plan. Give an illustration to double sampling plan. Also obtain ASN for double sampling plan

26. Solving the following LPP graphically

Maximize $Z = 45x_1 + 80x_2$

Subject to the constraints : $5x_1 + 20x_2 \leq 400$

$10x_1 + 15x_2 \leq 450,$

$x_1, x_2 \geq 0.$

27. Explain Hungarian algorithm for solving assignment problem.

28. Define Transportation problem and Assignment problem. Show that Assignment problem is a special case of a Transportation problem.

(3 × 8 = 24 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

29. What do you mean by SQC ? Discuss its importance, utility advantages and limitations.

30. You are given the values of sample mean($\overline{X}$) and the range (R) for the samples of size 5 each. Draw the mean and range control charts and comment on the state of control. You may use the following control chart constants for $n = 5$ $A_2 = .58$, $D_3 = 0$, $D_4 = 2.115$.

Sample no.	1	2	3	4	5	6	7	8	9	10
$\overline{X}$	43	49	37	4	5	37	51	46	43	47
R	5	6	5	7	7	4	8	6	4	6

31. Explain Simplex procedure to solve a linear programming problem. How do you recognize optimality in the simplex method ?

32. Determine an initial basic feasible solution to the following Transportation Problem using North West Corner Rule.

	D_1	D_2	D_3	D_4	Available
O_1	6	4	1	5	14
O_2	8	9	2	7	16
O_3	4	3	6	2	5
required	6	10	15	4	35

(2 × 10 = 20 marks)

D 90270

(Pages : 3)

Name.......................................

Reg. No..................................

FIFTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CUCBCSS—UG)

Statistics

STS 5B 07—SAMPLE SURVEYS

Time : Three Hours　　　　　　　　Maximum : 80 Marks

Section A

Answer **all** *questions.*
Each question carries 1 *mark.*

Name the following :

1. Interviewing all members of a given population is called
2. Which sampling method is used when there is maximum heterogeneity within the class
3. Simple random sampling in which a sampling unit can be repeated more than once is called

Fill up the blanks :

4. In proportional allocation the sample strata size is proportional to ——————.
5. The variance of unbiased estimate of population mean in SRSWOR is ——————.
6. In —————— sampling method there is maximum homogeneity within the class and maximum heterogeneity between the class.
7. If n is the sample size and N is the population size then n/N is called ——————.

Write True *or* False :

8. In SRSWOR sample mean square is an unbiased estimator of population mean square.
9. The error due to faulty planning of a survey is a non sampling error.
10. $V(\bar{y}_{st})$ opt $\leq V(\bar{y}_{st})$ prop $\leq V(\bar{y})$srswor.

(10 × 1 = 10 marks)

Turn over

Section B

Answer **all** *questions.*
Each question carries 2 *marks.*

11. Explain random numbers method for selecting simple random samples.
12. Define The pre-test.
13. Define simple random sampling with replacement.
14. What are the merits of simple random sampling ?
15. What are the basic principles of stratification ?
16. Define proportional allocation in stratified random sampling.
17. Define systematic sampling.

(7 × 2 = 14 marks)

Section C

Answer at least **two** *questions.*
Each question carries 6 *marks.*
All questions can be attended.
Overall Ceiling 12.

18. Give the advantages of sampling over census.
19. In stratified random sampling prove that the estimate of mean $\bar{y}_{st}$ is unbiased estimator of population mean $\overline{Y}_N$.
20. Define cluster sampling. Give a short note on two stage cluster sampling
21. Distinguish between SRSWOR and SRSWR.
22. Find an unbiased estimator of population mean under systematic sampling.

(2 × 6 = 12 marks)

Section D

Answer at least **three** *questions.*
Each question carries 8 *marks.*
All questions can be attended.
Overall Ceiling 24.

23. Define probability sampling, Judgment sampling and mixed.
24. What are the principal steps involved in a sample survey.

25. Define SRSWOR. Estimate the variance of sample mean in SRSWOR.

26. Define stratified random sampling. Derive the expression for variance of estimate of sample mean $\bar{y}_{st}$ in stratified random sampling.

27. Define systematic sampling. State the circumstances when systematic sampling is optimum.

28. When you use cluster sampling. Derive and unbiased estimator of population mean under cluster sampling.

(3 × 8 = 24 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

29. Define sampling. State the advantages of sampling over census. What are the different sources of errors in a sample survey.

30. If the population consist of a linear trend then prove that $V(\bar{y}_{st}) \leq V(\bar{y}_{sys}) \leq V(\bar{y})$srswor.

31. Define systematic sampling. Find an unbiased estimator for of population mean. Compare the efficiency of systematic sampling with stratified random sampling.

32. Prove that in simple random sampling sample proportion is an unbiased estimator of population proportion. Also find its variance.

(2 × 10 = 20 marks)

D 90269

(Pages : 3)

Name..................................

Reg. No...............................

FIFTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION
NOVEMBER 2020

(CUCBCSS—UG)

Statistics

STS 5B 06—STATISTICAL COMPUTING

Time : Three Hours | Maximum : 80 Marks

Section A

Answer **all** *questions.*
Each question carries 1 *mark.*

1. What is the output of the R command seq (1, 10, *by* = 2) ?
2. Write down the R-command to find P (X = 3),for X follows exponential with mean 25.
3. If *p*-value is 0.3051 is an output, what will be your inference ?
4. How do you determine 1st quartile of N (10, 1.8) ?
5. Write down R-command to find one-way ANOVA.
6. If A and B are 3 × 3 matrices, what will give A*B ?
7. Write down the R-command for difference of proportion.
8. Write down the R-command to draw a histogram.
9. What is the R command to get the critical value $N_{\alpha/2}$ in normal test, for = 0.05 ?
10. What are the three options of the argument "alternative" in the t.test command ?

(10 × 1 = 10 marks)

Section B

Answer **all** *questions.*
Each question carries 2 *mark.*

11. How do you install R in your computer ?
12. What is 95 % percentile of standard normal distribution ? Write down R-command to get this value.

Turn over

13. What do you mean by workspace ? Also explain how to save the workspace ?
14. How will you test the normality of the given data?
15. Briefly explain the arguments of the command var.test ().
16. Explain data.frame() in R.
17. Write a short note on acceptable object names.

(7 × 2 = 14 marks)

Section C

Answer at least **two** *questions.*
Each question carries 6 *marks.*
All questions can be attended.
Overall Ceiling 12.

18. How do you save, store and retrieve work in R ?
19. Distinguish between the functions qnorm() and rnorm().
20. What do you mean by paired *t*-test ? How will you conduct it in R ?
21. Explain the use of box plot. Give the R command to draw the box plot.
22. Give a set of R commands to draw a systematic random sample of 6 observations from a population of 30 observations.

(2 × 6 = 12 marks)

Section D

Answer at least **three** *questions.*
Each question carries 8 *marks.*
All questions can be attended.
Overall Ceiling 24.

23. Explain how will you import data in R from Excel.
24. Explain goodness of test. Write down the R command to test.
25. Describe the program to test the equality of variances in R.
26. Write R program to draw greater than ogive for the following data.

Weight in kgs	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89
No.of persons	23	64	152	77	36

27. Explain how will you conduct regression analysis in R ? Also explain the use of summary function.

28. Explain the method of fitting linear regression model. How do you test significance of the model? Write down the R command for this.

(3 × 8 = 24 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

29. Explain the methods of data input in R.

30. Explain how to find interval estimate of the difference of two population means in the following cases.

    (i) When the population standard deviations are known.

    (ii) When population standard deviations are unknown but equal.

    Write the corresponding R commands.

31. Write the short note on history of R. What are the advantages of R over other statistical softwares?

32. Write down the R command for :

    (a) Generating random sample of size 200 from a normal distribution with mean 10 and variance 16.

    (b) Finding the third quartile, sixth decile and 80th percentile of generated sample.

    (c) Drawing the Q-Q plot of the generated sample.

    (d) Test whether the mean of the population is 10.

    (e) Constructing 95% confidence intervals for the population mean.

(2 × 10 = 20 marks)

D 90268 (Pages : 3) Name.......................................

Reg. No..................................

FIFTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CUCBCSS—UG)

Statistics

STS 5B 05—MATHEMATICAL METHODS IN STATISTICS

Time : Three Hours Maximum : 80 Marks

Section A

Answer **all** *questions.*
Each question carries 1 *mark.*

Name the following :

1. If either $\lim_{x\to a^-} f(x)$ or $\lim_{x\to a^+} f(x)$ or both do not exist, then $f(x)$ is :
2. If $\{a_n\}$ is decreasing sequence of positive number $\sum a_n$ an converges, then $\lim_{n\to\infty} na_n$ is :
3. If f is a non-negative continuous function on $[a,b]$ and $\int_a^b f(x)\,dx = 0 \forall x \in [a\ b]$ then $f(x)$ is :

Fill up the blanks :

4. The value of $\lim_{x\to 2} \frac{x^2-4}{x-2}$ is ————.
5. The series $1^3 + 2^3 + 3^2 + \ldots$ is ————.
6. The sequence $\{X_n\}$ where $X_n = \left(1+\frac{1}{n+1}\right)^n$ converges to ————.
7. Every Convergent sequence is ————.

Write True *or* False :

8. The sequence $\{1+(-1)^n\}$ has exactly two constant subsequence.
9. If f is uniformly continuous on a bounded interval I then f is bounded on I.
10. The function $f(x) = \sin x$ is not uniformly continuous in $[0\ \infty)$.

(10 × 1 = 10 marks)

Turn over

Section B

Answer **all** *questions.*
Each question carries 2 *marks.*

11. State Cauchy's Root Test.

12. State Monotone Convergence Theorem.

13. If $\{a_n\},\{b_n\}$ be two sequence such that $\lim a_n = a$ and $\lim b_n = b$, then show that $\lim(a_n b_n) = ab$.

14. Show that $\lim_{x \to 3} \frac{1}{(x-3)^4} = \infty$.

15. Define Uniform Continuity.

16. If $\lim_{x \to a} f(x)$ exist, prove that it must be unique.

17. Show that the function $f(x) = \frac{1}{x}$ is not uniformly continuous on [0, 1].

(7 × 2 = 14 marks)

Section C

Answer at least **two** *questions.*
Each question carries 6 *marks.*
All questions can be attended.
Overall Ceiling 12.

18. State and prove Lagrange's Mean Value Theorem.

19. Test the convergence of $1 + \frac{x^2}{2^p} + \frac{x^4}{4^p} + \ldots$.

20. Show that a constant function is integrable.

21. Prove that $\int_{\underline{a}}^{b} f(x)\,dx \le \int_{a}^{\bar{b}} f(x)\,dx$.

22. State and prove Convergence of monotonic sequence.

(2 × 6 = 12 marks)

Section D

Answer at least **three** *questions.*
Each question carries 8 *marks.*
All questions can be attended.
Overall Ceiling 24.

23. Show that $\lim_{n \to \infty} \left\{1 + \frac{1}{2} + \ldots + \frac{1}{n}\right\} = \infty$.

24. State and prove Cauchy's first theorem on limits.

25. Test for convergent of the series

$$\frac{\alpha}{\beta}+\frac{1+\alpha}{1+\beta}+\frac{(1+\alpha)(2+\alpha)}{(1+\beta)(2+\beta)}+\dots$$

26. Show that $\int_1^2 f(x)\,dx=\frac{11}{2}$ where $f(x)=3x+1$ using Riemann integral as a limit of sum.

27. State and prove Darboux's Theorem.

28. Test the convergence of $\frac{1}{1.2.3}+\frac{3}{2.3.4}+\frac{5}{3.4.5}+\dots.$

(3 × 8 = 24 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

29. i) State and prove fundamental theorem of integral Calculus.

ii) Compute $\int_{-1}^{1}|x|\,dx$ using Riemann integral as a limit of sum.

30. Prove that $\Sigma\frac{1}{n^P}$ converges when P > 1 and diverges when $P \le 1$.

31. State and prove Rolle's theorem. Examine the validity of the hypothesis and the conclusion of Rolle's theorem for $f(x)=x^3-4x$ on $[-2,2]$.

32. Examine the continuity of the function :

(i) $f(x)=\begin{cases}\frac{e^{1/x}-e^{-1/x}}{e^{1/x}+e^{-1/x}}, & x\neq 0\\ 1, & x=0\end{cases}$

(ii) $f(x)=\begin{cases}(1+x)^{1/x}, & x\neq 0\\ 1, & x=0\end{cases}$

(2 × 10 = 20 marks)

D 10708 (Pages : 2) Name..................................

Reg. No..............................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CBCSS—UG)

Statistics

STA 5D 03—BASIC STATISTICS

(2019 Admissions)

Time : Two Hours Maximum : 60 Marks

Use of calculator and Statistical table are permitted.

Section A (Short Answer Type Questions)

Answer at least **eight** *questions.*

Each question carries 3 *marks.*

All questions can be attended.

Overall Ceiling 24.

1. Define census.
2. Define primary data.
3. Define judgment sampling.
4. The mean of a set of 10 observations is 15. Identify the sum of the observations.
5. Define mode.
6. Standard deviation of a set of observations is 10. Each of the observations is added by 5. What will be the standard deviation of the new set ? Why ?
7. What is a scatter diagram ?
8. For a set of observations on the variables X and Y, Cov (X,Y) = 10, variances of X and Y are respectively 25 and 36. Calculate Pearson's coefficient of correlation for X and Y.
9. Define (i) Mutually exclusive ; (ii) Exhaustive events.
10. Define the terms (i) sample space ; (ii) event.
11. What is the frequency definition of probability ?
12. Given $P(A) = 0.7$, $P(B) = 0.5$, $P(A \cup B) = 0.9$, identify $P(A \cap B)$.

(8 × 3 = 24 marks)

Turn over

Section B

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. Explain any four methods for collecting primary data.
14. Define sampling. Mention any four advantages of sampling over census.
15. The mean weight of 30 students is 65.8 kgs. Later it was found that the weight of one boy was misread as 75 instead of the correct values 95. Calculate the correct average.
16. Sum of 10 observations is 80. Sum of the squares of these observations is 2330. Calculate the standard deviation of these 10 observations.
17. Write a note of fitting of a straight line.
18. Define conditional probability. If P (A) = 0.4, P (B) = 0.8, P (A/B) = 0.5. Find $P(A \cup B)$ and P(B/A).
19. Define independent events. If A and B are independent events with P (A) = 0.6, P (B) =0.5 ; find (i) $P(A \cap B)$ (ii) $P(A \cup B)$ (iii) $P(A \cap B^c)$.

(5 × 5 = 25 marks)

Section C

Answer any **one** *question.*
The question carries 11 *marks.*

20. The prices of a commodity in ten different stores of two cities A and B are noted. Which city is more consistent when the prices of the commodity are concerned ?

City A	24	25	22	22	25	23	23	24	20	26
City B	20	23	26	25	25	23	22	21	23	22

21. The corresponding values of two variables X and Y are given below. Calculate Pearson's coefficient of correlation between X and Y.

X	:	8	9	10	11	12	13
Y	:	10	15	18	20	22	25

(1 × 11 = 11 marks)

D 10707 (Pages : 2) Name.......................................

Reg. No..................................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CBCSS—UG)

Statistics

STA 5D 02—QUALITY CONTROL

(2019 Admissions)

Time : Two Hours Maximum : 60 Marks

Use of calculator and statistical table are permitted.

Section A (Short Answer Type Questions)

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. Define the term Statistical Quality Control.
2. When we say that a production process is in a state of statistical control ?
3. Define control chart.
4. Name the two control charts for variables.
5. Define product control.
6. When we use 'np' chart ?
7. Define acceptance sampling plan.
8. Explain the term natural tolerance limits.
9. Define consumer's risk.
10. Write thè two applications of c chart.
11. Define OC curve.
12. What is single sampling plan ?

(8 × 3 = 24 marks)

Turn over

Section B (Short Essay/Paragraph Type Questions)

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. Distinguish between chance cause of variation and assignable cause of variation production process.

14. Explain Double sampling plan.

15. Write a short note on revised control chart.

16. Explain the construction of sigma chart.

17. Define the terms : (1) ASN ; and (ii) AOQ.

18. Explain the uses of SQC.

19. Write a short note on c-chart.

(5 × 5 = 25 marks)

Section C (Essay Type Questions)

Answer any **one** *question.*
The question carries 11 *marks.*

20. Explain the construction of X-bar chart.

21. The following figures gives the number of defectives in 20 samples, each sample consists of 2000 items : 425, 430, 216, 341, 225, 322, 280, 306, 337, 305, 356, 402, 216, 264, 126, 409, 193, 326, 280, 389.

    Construct *p* chart and comment on the state of control of the process.

(1 × 11 = 11 marks)

D 10706 **(Pages : 2)** **Name...**

Reg. No....................................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CBCSS—UG)

Statistics

STA 5D 01—ECONOMIC STATISTICS

(2019 Admissions)

Time : Two Hours Maximum : 60 Marks

Use of calculator and Statistical table are permitted.

Section A (Short Answer Questions)

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. Define time series.
2. Define cyclical variation in a time series.
3. Identify the trend value for the year 2025, when the trend line is $y = -0.046t + 98.95$.
4. Define a growth curve.
5. Illustrate an example for seasonal variation in a time series.
6. Define seasonal index.
7. Differentiate price and quantity index numbers.
8. Explain the terms 'base year' and 'current year' while constructing index numbers.
9. Find the price index of a number based on the year 2005 to the year 2000. The prices in 2005 and 2000 are given as 130 and 105.
10. Define Laspayer's price index number.
11. Define splicing of index numbers.
12. Define consumer price index number.

(8 × 3 = 24 marks)

Turn over

Section B (Short Essay/Paragraph Type Questions)

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. List out any four objectives of time series analysis.

14. Differentiate additive and multiplicative models of time series.

15. Explain the method of semi average for identifying trend line.

16. Obtain the trend values using three year moving average method :

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Profit :	13	16	15	17	20	18	22	19	22

17. Explain the problems while constructing an index number.

18. Following are the index numbers based on the year 2001. Find the index numbers by shifting the base to 2004 :

Year :	2001	2002	2003	2004	2005
Index :	100	120	150	180	225

19. Construct Paache's price index number from the following data for a set of commodities based on 2005 to 2010.

Commodity	2005		2010	
	Price	Quantity	Price	Quantity
A	10	8	14	6
B	14	10	15	6
C	12	12	18	12

(5 × 5 = 25 marks)

Section C (Essay Questions)

Answer any **one** *question.*
The question carries 11 *marks.*

20. (i) Explain the method of fitting a linear trend to a time series data.

(ii) Fit a linear trendto the following time series data :

Year	1976	1977	1978	1979	1980	1081	1982	1983
Profit	80	90	92	83	94	99	92	110

21. Define Fishers index number. Show that Fishers index number satisfies (i) time reversal test and (ii) factor reversal test.

(1 × 11 = 11 marks)

D 10704 **(Pages : 2)** **Name....................................**

Reg. No.................................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CBCSS—UG)

Statistics

STA 5B 07—LINEAR REGRESSION ANALYSIS

(2019 Admissions)

Time : Two Hours and a Half Maximum : 80 Marks

Use of Calculator and Statistical tables are permitted.

Section A (Short Answer Type Questions)

Answer at least **ten** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 30.

1. Define Response variable and explanatory variable.
2. Define autocorrelation.
3. What are the uses of regression ?
4. Describe coefficient of determination in linear regression model.
5. Define hat matrix.
6. Write down the test statistic for testing the significance of intercept in simple linear regression model.
7. Write down the ANOVA table for testing the significance of regression model in simple linear regression model.
8. Explain the role of residual plots in regression analysis.
9. Define PRESS residual.
10. Write a situation where logistic regression is applicable.
11. Define polynomial regression model in two variables.
12. Define the outliers and explain their effect on regression analysis.
13. Find the least squares estimate of σ^2 in multiple linear regression models.

Turn over

14. How to identify the departure from normality ? Explain.

15. What are the important scaled residuals used in regression analysis ?

(10 × 3 = 30 marks)

Section B (Short Essay/Paragraph Type Questions)

Answer at least **five** *questions.*
Each question carries 6 *marks.*
All questions can be attended.
Overall Ceiling 30.

16. Describe multiple linear regression models. Estimate the parameters in multiple linear regression models.

17. Estimate the variance of parameters in simple linear regression model.

18. Explain the concept of residual analysis.

19. Explain the test procedure for significance of regression in multiple regression models.

20. Discuss the method of splines in polynomial fitting.

21. Fit a simple regression model for the following data and interpret the result

X		1	2	3	4	5	6	7	8
Y	:	1	1.2	1.8	2.5	3.6	4.7	6.6	9.1

22. Let $Y = X\beta + \epsilon$ be a general linear model with $\epsilon \sim N(0, \sigma^2)$ and X be a matrix of full rank. Obtain the maximum likelihood estimate of β.

23. Describe multiple linear regression models. Obtain a $100(1-\alpha)\%$ confidence interval for regression coefficient β_j in multiple linear regression model.

(5 × 6 = 30 marks)

Section C (Essay Type Questions)

Answer any **two** *questions.*
Each question carries 10 *marks.*

24. Derive the least squares estimate of simple linear regression model and show that they are unbiased.

25. Explain polynomial regression model in one variable. Explain piecewise polynomial fitting.

26. Briefly explain the model adequacy procedure in regression analysis.

27. What are the assumptions of linear regression model ? Explain the test procedure for significance of regression in multiple regression models.

(2 × 10 = 20 marks)

D 10703 **(Pages : 3)** **Name...**

Reg. No....................................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CBCSS—UG)

Statistics

STA 5B 06—SAMPLE SURVEYS

(2019 Admissions)

Time : Two Hours and a Half Maximum : 80 Marks

Use of Calculator and Statistical tables are permitted.

Section A (Short Answer Type Questions)

Answer at least **ten** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 30.

1. What is meant by Sampling design ? Give an example.
2. Distinguish between investigator bias and respondent bias.
3. Mention situations where sampling method alone can be used.
4. What is meant by sampling frame ? Give examples.
5. What is the probability of selecting a sample of size 3 from a population of size 10, if sampling is done according to simple random sampling without replacement ?
6. What is a random number table ? What is its use ?
7. Show that $\hat{Y} = N\bar{y}$ is an unbiased estimator of population total under SRSWOR.
8. Explain finite population correction.
9. What do you mean by correction for continuity ?
10. What type of sampling would you adopt when the population is heterogeneous ? Explain.
11. Obtain the confidence interval for population mean under stratified random sampling.
12. What is $V(\bar{y}_{st})$ under proportional allocation ?
13. Explain how you will draw a linear systematic sample.
14. Give the expression of relative efficiency of cluster sampling compared to a SRSWOR of nM elements from the whole population.

Turn over

15. Show that $(NM-1)S^2 = N(M-1)S_w^2 + M(N-1)S_b^2$.

(10 × 3 = 30 marks)

Section B (Short Essay/Paragraph Type Questions)

Answer at least **five** *questions.*
Each question carries 6 *marks.*
All questions can be attended.
Overall Ceiling 30.

16. Distinguish between sampling and non-sampling errors. How do you control non-sampling errors ?

17. Distinguish between probability and non-probability sampling. Give examples.

18. In SRSWR, show that $V(\bar{y}) = \left(\frac{N-1}{N}\right)\frac{S^2}{n}$, where $S^2 = \frac{1}{N-1}\sum_{i=1}^{N}\left(Y_i - \bar{Y}\right)^2$.

19. Suggest an unbiased estimator of population proportion under SRSWOR. Derive the expression for its variance.

20. Show that in stratified random sampling $V(\bar{y}_{st})$ is minimum for fixed total size of the sample 'n' if $n_h \infty N_h S_h$.

21. A flood affected district in Kerala is divided into three zones. The number of villages in each zone is given by 440, 405, and 100 respectively. In order to estimate the total number of houses affected by flood in the district, the number of villages selected from each zone are 25, 15 and 8 respectively. If total number of houses affected in the sampled villages are 750, 600, 344 respectively, estimate the total number of houses affected by flood in the district.

22. Prove that the variance of the mean of a systematic sample is

$$V(\bar{y}_{sy}) = \frac{N-1}{N}S^2 - \frac{k(n-1)}{N}S_{wsy}^2$$

where $S_{wsy}^2 = \frac{1}{k(n-1)}\sum_{i=1}^{k}\sum_{j=1}^{n}\left(y_{ij} - \bar{y}_i\right)^2$.

23. Give an unbiased estimator of population total based on cluster sampling where the clusters are of equal size. What is the variance of your estimator ?

(5 × 6 = 30 marks)

Section C (Essay Type Questions)

Answer any **two** *questions.*
Each question carries 10 *marks.*

24. Describe various steps in planning and execution of a large scale sample survey.

25. (a) Explain random number table method of selecting a simple random sample.

    (b) Nine villages in a certain administrative area contain 793, 170, 970, 657, 1721, 1603, 864, 383 and 826 fields respectively. Make a random selection of 6 fields using the random numbers 7358, 922, 4112, 3596, 633 and 3999.

26. Show that $V_{opt} \leq V_{prop} \leq V_{ran}$ where V_{opt}, V_{prop} and V_{ran} are the variances of the sample mean under optimum allocation, proportional allocation and SRSWOR respectively.

27. In SRSWOR of '*n*' clusters from a population of N clusters each containing M elements, prove that

$$V(\bar{\bar{y}}) = \frac{N-n}{Nn}\frac{NM-1}{NM-M}\frac{S^2}{M}\left\{1+\left(M-1\rho_{cl}\right)\right\}.$$

(2 × 10 = 20 marks)

D 10702 (Pages : 3) Name..............................

Reg. No..............................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CBCSS—UG)

Statistics

STA 5B 05—MATHEMATICAL METHODS IN STATISTICS

(2019 Admissions)

Time : Two Hours and a Half Maximum : 80 Marks

Use of Calculator and Statistical tables are permitted.

Section A (Short Answer Type Questions)

Answer at least **ten** *questions.*
Each question carries 3 marks.
All questions can be attended.
Overall Ceiling 30.

1. Define algebraic property of R.

2. What is nested interval property ?

3. Show that for any real number x, $\lim_{n \to \infty} \frac{x^n}{n!} = 0$.

4. Show that the series $\frac{1}{1^p} - \frac{1}{2^p} + \frac{1}{3^p} - \frac{1}{4^p} \cdots$ converges for $p > 0$.

5. Find infimum and supremum of the following sets :

   (i) $\left\{\frac{(-1)^n}{n}\right\}; n \in \text{N}$.

   (ii) $\left\{\frac{1}{n}\right\}; n \in \text{N}$.

6. What do you mean by alternating series ? Also define Leibnitz test.

7. Discuss the monotonicity of the sequence $\left\{\frac{1}{n}\right\}; n \in \text{N}$.

Turn over

8. Define Uniform continuity of a function in an interval.

9. Check the differentiability of the function $f(x) = |x|$ at the point $x = 0$.

10. State Roll's theorem.

11. Write down the condition under which a function f is having discontinuity of the first kind.

12. State any *two* properties of Riemann integral.

13. Define refinement of a partition.

14. Discuss the continuity of the function $f(x) = [x]$ at $x = 3$.

15. Evaluate $\lim_{x \to 0} \dfrac{3x + |x|}{7x - 5|x|}$.

(10 × 3 = 30 marks)

Section B (Short Essay/Paragraph Type Questions)

Answer at least **five** *questions.*
Each question carries 6 *marks.*
All questions can be attended.
Overall Ceiling 30.

16. Prove that set of real numbers is not countable.

17. Prove that in between two real number there is an irrational number.

18. State and prove density theorem.

19. If $a > 0$ and p is a real number, then find $\lim_{n \to \infty} \dfrac{n^p}{(1+a)^n}$.

20. State and prove Lagrange's mean value theorem.

21. Prove that $f(x) = \sin x^2$ is not uniformly continuous on $[0, \infty[$.

22. If a function is continuous on a closed interval $[a, b]$, then prove that it attains its bound at least once.

23. If f_1 and f_2 are Riemann integrable, prove that $f_1 + f_2$ is also Riemann integrable.

(5 × 6 = 30 marks)

Section C (Essay Type Questions)

Answer any **two** *questions.*
Each question carries 10 *marks.*

24. State and prove principle of mathematical induction.

25. If $\sum u_n$ and $\sum v_n$ are two positive term series, and $u_n < kv_n, \forall\, n \geq m, k \geq 0$ then show that :

    (a) $\sum u_n$ is convergent, if $\sum v_n$ is convergent ; and

    (b) $\sum v_n$ is divergent, if $\sum u_n$ is divergent.

26. State and prove a necessary and sufficient condition for the integrability of a function.

27. Show that a function continuous on a closed interval is uniformly continuous on that interval.

(2 × 10 = 20 marks)

D 10273

(Pages : 2)

Name.......................................

Reg. No..................................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CUCBCSS—UG)

Statistics

STS 5D 01—ECONOMIC STATISTICS

Time : Two Hours　　　　Maximum : 40 Marks

Section A

Answer all **five** *questions.*
Each question carries 1 *mark.*

1. A time series consists of at the most ———— components.
2. The random component of a time series is known as ————.
3. For the additive model sum of the seasonal indices is ————.
4. Paasche's method uses the ———— quantities as weights.
5. Family budget method is used for constructing ———— index numbers.

(5 × 1 = 5 marks)

Section B

Answer all **five** *questions.*
Each question carries 2 *marks.*

6. What is a time series ?
7. Explain chain base index number.
8. What are the four different phases in a business cycle.
9. Write the names of any two tests to be satisfied by a good index number.
10. Explain family budget method.

(5 × 2 = 10 marks)

Section C

Answer any **three** *questions.*
Each question carries 5 *marks.*

11. What are the advantages and disadvantages of the moving average method ?
12. Distinguish between seasonal variation and cyclical variation in a time series.

Turn over

13. Discuss various problems involved in the construction of index numbers.

14. Explain weighted and unweighted index numbers.

15. Discuss various steps involved in the construction of consumer price index.

(3 × 5 = 15 marks)

Section D

Answer any **one** *question.*
The question carries 10 *marks.*

16. Define trend. Explain the various methods of estimating trend in a time series.

17. Calculate Fisher's index numbers from the following data and show that it satisfies the time reversal test and factor reversal test :

Commodity	Price		Quantity	
	Base year	Current year	Base year	Current year
A	5	8	10	1
B	6	24	18	3
C	8	11	8	1
D	3	12	6	4

18. The data below gives the average quarterly prices of a commodity for five years. Calculate seasonal indices by the method of link relatives

	Year				
Quantities	I	II	III	IV	V
A	30	35	31	31	34
B	26	28	29	31	36
C	22	22	28	25	26
D	31	36	32	35	33

(1 × 10 = 10 marks)

D 10272 (Pages : 3) Name.................................

Reg. No.................................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CUCBCSS–UG)

Statistics

STS 5B 09—PRACTICAL—Paper I

Time : Three Hours Maximum : 80 Marks

Use of Calculator and Statistical tables is permitted.

Answer any **four** *questions.*
Each question carries 20 *marks.*

1. (a) To find certain vaccination prevents a certain disease or not, an experiment was conducted, the following figures obtained, test whether vaccination is effective or not ?

	Vaccinated	*Non - vaccinated*
Attacked by disease	69	10
Not attacked by the disease	91	30
Total	160	40

(b) Two independent samples of sizes 10 and 8 from two normal populations gave the following observations :

Sample 1	16	13	12	15	16	14	10	13	11	14
Sample 2	12	14	10	13	12	13	14	12		

Could the populations have equal variances at 5 % level.

(10 + 10 = 20 marks)

2. (a) The nicotine content (in milligrams) of two samples of tobacco were found to be as follows :

Sample A	24	27	26	21	25	
Sample B	27	30	28	31	22	36

Can it be said that come from same normal population ? (Assuming they have same variance).

(b) An IQ test was administered to 5 persons before and after they were trained. The results are as follows :

Candiates	A	B	C	D	E
I.Q. before training	110	120	123	132	125
After training	120	118	125	136	121

Test whether there is any change in I.Q. after the training program ?

(10 + 10 = 20 marks)

Turn over

3. (a) The means of two large samples of 1000 and 2000 members are 67.5 and 68 inches respectively. Can the samples be regarded as drawn from the same population of standard deviation 2.5 inches. (at 5 % of significance)

(b) In a certain district A, 450 are found to be tea drinkers, out of 1000 persons. In another district B, 400 were regular consumers of tea out of a sample of 800 persons. Do these facts reveal a significant difference between two districts as far as tea drinking habits are concerned ?

(c) A researcher suggest that male nurses earn more than female nurses. A survey of 16 male nurses and 20 female nurses reports the data below is there enough evidence to support the claim ? Assume the data are given from normally distributed populations with same variance. Use $\alpha = 0.01$.

Females	*Males*
Mean wage Rs. 23,750	Mean wage 23,900
s_1 = Rs.250	s_2 = Rs.300
$n_1 = 20$	$n_2 = 16$

(6 + 6 + 8 = 20 marks)

4. (a) The breaking strength of steel rods said follow normal distribution with mean μ. To test this a sample of 14 rods were tested. The mean and standard deviations obtained were 17.85 and 1.955 thousand pounds respectively. Obtain 95 % confidence limits for the average breaking strength of steel rods μ.

(b) If 8.6, 7.9, 8.3, 6.4, 8.4, 9.8, 7.2, 7.8, 7.5 are observed values of a random sample of size 9 from $N(8, \sigma^2)$. Construct a 90 % confidence interval for variance.

(c) A random sample of 10 boys had the following IQ's : 70, 120, 110, 101, 88, 83, 95, 98, 107, 100. Do the data support the assumption that population mean of IQ is 100 ? Find a reasonable range in which sample mean of IQ of 10 boys will lie ? Confidence interval for mean Z.

(6 + 7 + 7 = 20 marks)

5. Consider a population of 5 households from a small colony, having monthly income in (000 Rs.) as follows :

Household	1	2	3	4	5
Income (000 Rs.)	156	149	166	164	155

(i) Enumerate all possible samples of size 2 by SRSWOR.

(ii) Show that sample mean is unbiased estimate of population mean.

(iii) Calculate population and sample variance.

(iv) Show that sample mean square s^2 is the unbiased estimate of population mean square S^2.

6. (a) A random sample of 27 pairs of observation from normal population gave a correlation coefficient 0.6. Is this significant of correlation in the population.

(b) Before increasing excise duty on tea 800 persons out of a sample of 1000 persons were found to be tea drinkers. After increasing an excise duty 800 people were tea drinkers in the sample of 1200 people. Test whether there is significant decrease *n* the consumption of tea after the increase in excise duty.

(c) A department store, A has four competitors: B, C, D, E. Store A hires a consultant to determine, the preference of shoppers. A survey of 1100 randomly selected shoppers is conducted, and following table of preferences were obtained. Is there enough evidence to conclude that the proportions are the same ?

Stores	A	B	C	D	E
Number of shoppers	262	234	204	190	210

(6 + 6 + 8 = 20 marks)

D 10271

(Pages : 3)

Name.................................

Reg. No.............................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CUCBCSS–UG)

Statistics

STS 5B 08—OPERATIONS RESEARCH AND STATISTICAL QUALITY CONTROL

Time : Three Hours

Maximum : 80 Marks

Section A

Answer **all** *questions.*
Each question carries 1 mark.

1. In SQC, the process control is achieved through the technique of ————.
2. In control chart, any point which lies outside the control limit is clear indication of ————.
3. ———— is used for controlling the variations of items of the product.
4. The abbreviation ASN stands for ————.
5. In Acceptance Sampling Plan, the probability of rejecting a lot with satisfactory quality usually termed as ————.
6. Any solution to the LPP, which satisfies all the constraints and non-negativity restrictions is called ————.
7. The right hand side constant of a constraint in a primal problem appears in the corresponding dual as ————.
8. Necessary and sufficient condition for existence of feasible solution to a transportation problem is that it is ————.
9. When the value of decision variable in linear programming problem is permitted to increase infinitely without violating the feasibility condition, then the solution is said to be ————.
10. The phenomenon of obtaining a degenerate basic feasible solution in a linear programming problem is known as ————.

(10 × 1 = 10 marks)

Section B

Answer any **seven** *questions.*
Each question carries 2 marks.

11. Distinguish between Process control and Product control.
12. Explain Single Sampling Plan.

Turn over

13. Explain the terms (a) AQL ; (b) LTPD.
14. List any two applications of C chart.
15. How are transportation problem and assignment problems related ?
16. Prove that dual of dual is primal.
17. Define slack and surplus variable.

(7 × 2 = 14 marks)

Section C

Answer any **three** *questions.*
Each question carries 4 *marks.*

18. Explain Acceptance Sampling and Quality of a lot.
19. Write a short note on (a) 3 Sigma Control limits ; (b) Modified Control Chart.
20. Explain Double Sampling Plan.
21. Solve the following LPP graphically :

    Maximize $Z = 3x_1 + 4x_2$

    subject to the constraints :

    $4x_1 + 2x_2 \leq 80$

    $2x_1 + 5x_2 \leq 180$

    $x_1, x_2 \geq 0$.
22. Explain Hungarian Assignment Method.

(3 × 4 = 12 marks)

Section D

Answer any **four** *questions.*
Each question carries 6 *marks.*

23. Explain variations in production process. When a production process is said to be in a statistical control ?
24. Describe Single Sampling Plan. Obtain Producer's Risk and Consumer's Risk for single sampling plan.
25. Discuss the basic principle underlying control charts. Explain the brief construction of *p* chart and *c* chart.
26. Define following terms (i) Basic variable ; (ii) Basic solution ; (iii) Basic feasible solution ; and (iv) Degenerate basic solution.
27. What are Primal and Dual problems of linear programming problem ? Describe the general rules for writing dual of a LPP.
28. Explain General linear programming problem. What are the basic components of a linear programming problem ?

(4 × 6 = 24 marks)

Section E

Answer any **two** *question.*
Each question carries 10 *marks.*

29. Explain a method of solving Transportation problem.

30. Use Simplex method to solve the following LPP :

    Maximize $Z = x_1 + 2x_2$

    subject to the constraints :

    $$-x_1 + 2x_2 \leq 8$$
    $$x_1 + 2x_2 \leq 12$$
    $$x_1 - 2x_2 \leq 3$$
    $$x_1, x_2 \geq 0.$$

31. What is a Control chart ? Describe control chart for variables. Explain in detail the constructions of control chart for mean and range in a production process.

32. Define Acceptance Sampling. Describe double sampling. Give an illustration to Double Sampling Plan. Also obtain ASN for double sampling plan.

(2 × 10 = 20 marks)

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(Pages : 2)

Name.......................................

Reg. No.....................................

FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CUCBCSS—UG)

Statistics

STS 5B 07—SAMPLE SURVEYS

Time : Three Hours

Maximum : 80 Marks

Section A

Answer **all** *questions in* **one** *word.*
Each question carries 1 *mark.*

Name the following :

1. The constant representing population characteristic is known as ————.
2. The number of possible samples of size n from a population of N units without replacement is ————.
3. Standard deviation of sampling distribution of any statistic is called ————.

Fill up the blanks :

4. ———— is the trying out the questionnaire and field methods on a small scale.
5. The list of questions to be filled by the interviewer in a sample survey is called ————.
6. If n is the sample size and N is the population size then $1 - n/N$ is called ————.
7. The smallest element in a sample survey is ————.

Write True *or* False :

8. In SRSWOR sample variance is an unbiased estimator of population variance.
9. In sampling technique both sampling errors and non sampling errors are present.
10. $V(\bar{y}_{st})\text{opt} \geq V(\bar{y}_{st})\text{prop} \geq V(\bar{y})\text{srswor}$.

(10 × 1 = 10 marks)

Section B

Answer **all** *questions in* **one** *sentence each.*
Each question carries 2 *marks.*

11. Define Parameter and Statistic.
12. Define Sampling Frame.
13. Define simple random sampling.

Turn over

14. What is stratification ?
15. Define stratified random sampling.
16. What are the demerits of systematic sampling ?
17. Define questionnaire.

(7 × 2 = 14 marks)

Section C

Answer any **three** *questions.*
Each question carries 4 *marks.*

18. Define sampling. What are the limitations of sampling ?
19. Define the different methods of selection of simple random sample.
20. In SRSWOR prove that sample mean square is an unbiased estimator of population mean square.
21. Define stratified random sampling. Explain the Neyman Allocation in stratified random sampling.
22. State the circumstances when systematic sampling is optimum.

(3 × 4 = 12 marks)

Section D

Answer any **four** *questions.*
Each question carries 6 *marks.*

23. State the advantages of sampling over.
24. Define sample survey. What are the different sources of errors in a sample survey.
25. Define cluster sampling. Compare the precision of cluster sampling with simple random sampling.
26. Prove that in simple random sampling sample proportion is an unbiased estimator of population proportion.
27. Define stratified random sampling. What are the advantages and disadvantages of stratified random sampling.
28. Define systematic sampling. What are the merits and demerits of systematic sampling.

(4 × 6 = 24 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

29. What are the main steps involved in a sample survey ? Discuss the briefly.
30. Compare the efficiencies of SRSWOR, Stratified random sampling and systematic sampling.
31. What are the different types of allocation of sample sizes in stratified random sampling. Compare their efficiencies.
32. Define systematic sampling. Derive the expression for variance of estimate of population mean. Compare the efficiency of systematic sampling with simple random sampling.

(2 × 10 = 20 marks)

D 10269 (Pages : 3) Name.................................

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FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CUCBCSS–UG)

Statistics

STS 5B 06—STATISTICAL COMPUTING

Time : Three Hours Maximum : 80 Marks

Section A

Answer **all** *questions in one word.*
Each question carries 1 *mark.*

1. What is the output of the R command rep (1, 4) ?
2. Write down the R-command to find P(X = 3), for X follows binomial with parameters $n = 10$ and $p = 0.25$.
3. If p-value is 0.3051 is an output, what will be your inference ?
4. How do you determine 1st quartile of N(10, 1.8) ?
5. Write down R-command to find correlation co-efficient.
6. If A and B are matrices of same order, what will give A * B ?
7. Write down the R-command for difference of proportion.
8. Write down the R-command to draw a Pie chart.
9. What is the R command to get the critical value $Z\alpha/2$ in normal test, for = 0.05 ?
10. What are the three options of the argument "alternative" in the t test command ?

(10 × 1 = 10 marks)

Setcion B

Answer **all** *questions in one sentence.*
Each question carries 2 *marks.*

11. What do you mean by packages in R ?
12. What is 95 % percentile of standard normal distribution ? Write down R-command to get this value.
13. How do you install R in your computer ?
14. How will you test the normality of the given data ?
15. Briefly explain the arguments of the command var.test().
16. Explain data.frame() in R.
17. Write a short note on acceptable object names.

(7 × 2 = 14 marks)

Turn over

Setcion C

Answer any **three** *questions in* **a paragraph.**
Each question carries 4 *marks.*

18. Distinguish between the functions qnorm() and rnorm().
19. Explain the use of box plot. Give the R command to draw the box plot.
20. Describe the procedure for import a data file from MS-Word to R.
21. Give a set of R commands to draw a systematic random sample of 6 observations from a population of 30 observations.
22. Explain the plot to check, normality of data in R.

(3 × 4 = 12 marks)

Section D

Answer any **four** *questions.*
Each question carries 6 *marks.*

23. Explain goodness of test. Write down the R command to test.
24. Explain some methods to data input in R.
25. Describe the program to test the equality of variances in R.
26. Write down R command to determine correlation co-efficient, regression lines X on Y and Y on X for the following data :—

X	34	37	36	32	32	36	35	34	29	35
Y	37	37	34	34	33	40	39	37	36	35

27. Write down R command for generating a random sample of 400 observation from a exponential distribution with mean 20 and finding the quartiles of the sample.
28. Explain the method of fitting linear regression mode. How do you test significance of the model ? Write down the R command for this.

(4 × 6 = 24 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

29. Write down the R command for :
    (a) Generating random sample of size 200 from a normal distribution with mean 10 and variance 16.
    (b) Finding the third quartile, sixth decile and 80th percentile of generated sample.
    (c) Drawing the Q-Q plot of the generated sample.
    (d) Test whether the mean of the population is 10.
    (e) Constructing 95 % confidence intervals for the population mean.

30. Suppose that the number of screws produced by a sophisticated machine per day has a Poisson distribution with mean 2. What is the probability that out of total production of the day, there is :

   (a) No defective screw.

   (b) Exactly 2 defective screw.

   (c) Atleast one defective screw.

   (d) Atmost two defective screws.

31. Explain how will you conduct regression analysis in R. Also explain the use of summary function.

32. If X is a exponential random variable with parameter $\lambda = 2$, write down the R commands for the following probabilities :

   (a) $P(X = 0)$.

   (b) $P(X \leq 3)$.

   (c) $P(1 \leq X \leq 5)$.

(2 × 10 = 20 marks)

D 10268 (Pages : 3) Name..............................

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FIFTH SEMESTER U.G. DEGREE EXAMINATION, NOVEMBER 2021

(CUCBCSS–UG)

Statistics

STS 5B 05—MATHEMATICAL METHODS IN STATISTICS

Time : Three Hours Maximum : 80 Marks

Section A

Answer **all** *questions in one word.*
Each question carries 1 *mark.*

Name the following :—

1. If f is uniformly continuous on an interval I and $k \in \mathrm{R}$, then kf is :
2. If $\mathrm{P}* = \mathrm{P}_1 \cup \mathrm{P}_2, \mathrm{P}_1 \,\&\, \mathrm{P}_2$ are two partitions then P* is :
3. If sequence is not a Cauchy sequence, then it is :

Fill up the blanks :

4. Between any two distinct real numbers there exist ————.
5. If f is bounded and integrable on $[a, b]$ then $|f|$ is ————.
6. The value of $\lim_{x \to 0} \dfrac{\sqrt{4+x}-2}{x}$ is ————.
7. Let f be bounded and integrable function on $[a, b]$ then the function $\mathrm{F}(x) = \int_a^x f(t)\, dt$ is called ———— of f.

Write True or False :

8. Every convergent sequence is not bounded.
9. Limit of sequence $\mathrm{S}_n = \dfrac{3+2\sqrt{n}}{\sqrt{n}}$ is zero.
10. If $f(x)$ is continuous then $|f(x)|$ is continuous.

(10 × 1 = 10 marks)

Turn over

Section B

*Answer **all** questions in one sentence each.*
Each question carries 2 marks.

11. Define Inferior Superior Limit.
12. State D'Alembert's Ratio Test.
13. State Mean Value Theorem.
14. Test the convergence of $1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\ldots$.
15. Define Refinement of partitions.
16. If $\lim a_n = a \;\&\; a_n \geq 0 \forall n,$ then prove that $a \geq 0$.
17. Verify whether the function $f(x)=\sin x$ in $[0\ \pi]$ satisfies the conditions of Rolle's theorem.

(7 × 2 = 14 marks)

Section C

*Answer any **three** questions.*
Each question carries 4 marks.

18. Show that bounded and monotonic function is integrable on $[a, b]$.
19. Discuss the derivability of the following function :

$$f(x)=\begin{cases}2x-3;\ 0\leq x\leq 2\\ x^2-3;\ 2<x\leq 4\end{cases} \text{ at } x=2, 4.$$

20. State and prove Darboux's theorem.
21. Show that $\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$.
22. Prove that $\int_a^b f(x)\,dx \leq \int_a^{\bar{b}} f(x)\,dx$.

(3 × 4 = 12 marks)

Section D

*Answer any **four** question.*
Each question carries 6 marks.

23. State and prove Cauchy's root test.
24. Define types of discontinuity of function. Also discuss the continuity at $x = 3$ for the function $f(x) = x-[x]\ \forall x \geq 0$.
25. State and prove Rolle's theorem.

26. If f_1 & f_2 are two bounded and integrable functions, show that

$$\int_a^b (f_1 + f_2)\,dx = \int_a^b f_1 dx + \int_a^b f_2 dx.$$

27. Show that every continuous function is integrable.

28. Show that the function $f(x) = \begin{cases} \sin\left(\frac{1}{x}\right); & x \neq 0 \\ 0 \;\;\; ; & x = 0 \end{cases}$ is not uniformly continuous.

(4 × 6 = 24 marks)

Section E

Answer any **two** *question.*
Each question carries 10 *marks.*

29. Evaluate :

(a) $\lim_{x \to 1} \frac{1}{x-1}\left[\frac{1}{x+3} - \frac{2}{3x+5}\right]$.

(b) $\lim_{x \to 0} \frac{e^{1/x}}{1+e^{1/x}}$.

30. State and prove necessary and sufficient condition for Riemann integrability.

31. Test the convergence of the series :

$$1 + \frac{2}{5}x + \frac{6}{9}x^2 + \frac{14}{17}x^2 + \ldots + \frac{2^n - 2}{2^n + 1}x^{n-1} + \ldots ; x > 0.$$

32. State and prove Taylor's theorem.

(2 × 10 = 20 marks)