C 20690 (Pages : 2) Name.......................................

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

SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022

(CBCSS–UG)

Statistics

STA 6B 16 (E)—RELIABILITY THEORY

(2019 Admissions)

Time : Two Hours Maximum : 60 Marks

Section A

Answer atleast **eight** *questions.*
Each question carries 3 marks.
All questions can be attended.
Overall ceiling 24.

1. Draw a series system with *three* components.
2. Define a 2-out-of-3 systems.
3. When a component of a system is said to be irrelevant ?
4. Define a coherent system.
5. Define a path vector.
6. Define the dual of a coherent structure $\phi(X)$.
7. Write the reliability function of a series system with *two* identical and independent components.
8. Define the modular decomposition of a coherent system.
9. Define a minimal cut vector.
10. Define Poisson distribution.
11. If the average life of a component with Poisson life is 3, find P (X > 0).
12. If X follow exponential distribution with parameter λ, show that the average life is λ.

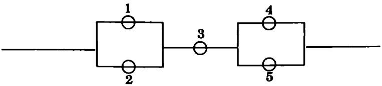
($8 \times 3 = 24$ marks)

Turn over

Section B

Answer atleast **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall ceiling 25.

13. Find the structure function of the system with the diagram :



14. If $h(p)$ is the reliability function of a coherent structure with n components, prove that $h(p)$ is strictly increasing in each p.

15. Explain aging.

16. Explain the concept of "bathtub shaped" failure rate.

17. Draw a parallel system with four identical components. Also find the reliability function of the system.

18. Define a system with : (i) IFR ; and (ii) DFR with a suitable example for each.

19. Prove that the mean and standard deviation of exponential distribution are same.

($5 \times 5 = 25$ marks)

Section C

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

20. (a) Establish that a parallel structure of n components is a 1-out-of-n structure and a series structure is a n-out-of-n structure.

    (b) Write a short note on the reliability importance of the system and that of the components.

21. (a) Find the : (i) Reliability function and (ii) Failure rate of a component with exponential life distribution with parameter λ.

    (b) If T have exponential distribution, show that $P(T > t + x / T > t) = P(T > x)$.

($1 \times 11 = 11$ marks)

C 20689 (Pages : 3) Name....................................

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

SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022

(CBCSS—UG)

Statistics

STA 6B 15 (E)—STOCHASTIC PROCESSES

(2019 Admissions)

Time : Two Hours Maximum : 60 Marks

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 probability generating function of a random variable X.

2. A random variable X has the pgf $P(s) = \left[(1+s)/2\right]^n$. Find mean of X.

3. Define stochastic processes and give one example.

4. Define a Markov process. List four basic type of Markov processes.

5. Let $\{X(s,t)\}$ is a stochastic process. What is the nature of $X(s,t)$ when (i) s is fixed ; and (ii) t is fixed.

6. Define irreducible Markov chain.

7. Write Chapman-Kolmogorov equation.

8. What is meant by steady state distribution of Markov chain.

9. Define n-step transition probability in a Markov chain.

10. What is a stochastic matrix ?

11. State ergodic theorem.

12. Define period of a state of a Markov chain.

(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. State and prove Bayes' theorem.

14. If $P(A) > P(B)$, then show that $P(A/B) > P(B/A)$.

15. The chance that Doctor A will diagnose a disease X correctly is 60 %. The chance that the patient will die by his treatment after correct diagnosis is 40% and the chance of death of wrong diagnosis is 70 %. A patient of Doctor A who had disease X died. What is the chance that his disease was diagnosed correctly ?

16. Find the pgf of a r.v. X with pmf $f(x) = p(1-p)^x, x = 0, 1, 2, 3, ..., 0 < p < 1$ and hence find its mean.

17. Suppose that the probability of a dry day (State 0) following a rainy day (state 1) is $\left(\frac{1}{3}\right)$. And that the probability of a rainy day following a dry day is $\left(\frac{1}{2}\right)$. Given that May 1 is a dry day, find the probability that May 3 is also a dry day.

18. Consider the Markov chain with state space $S = \{1, 2, 3\}$ having transition probability matrix $P = \begin{bmatrix} 0 & \frac{2}{3} & \frac{1}{3} \\ \frac{1}{2} & 0 & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$. Find the stationary distribution of the Markov chain.

19. Let $\{X_n, n = 1, 2, 3, ...\}$ be a Markov chain with 3 states $\{1, 2, 3\}$ and one steptransition probability matrix is $P = \begin{bmatrix} \frac{3}{4} & \frac{1}{4} & 0 \\ \frac{1}{4} & \frac{1}{2} & \frac{1}{4} \\ 0 & \frac{3}{4} & \frac{1}{4} \end{bmatrix}$.

    (i) Sketch the transition diagram ; and

    (ii) Write $P(X_2 = 2/X_1 = 1)$.

(5 × 5 = 25 marks)

Section C (Essay Type Questions)

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

20. Let $\{X_n, n = 1, 2, 3, \ldots\}$ be a Markov chain on the state space $S = \{0, 1, 2, 3\}$ with one step transition probability matrix is $P = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0.3 & 0 & 0.7 & 0 \\ 0 & 0.3 & 0 & 0.7 \\ 0 & 0 & 1 & 0 \end{bmatrix}$. The initial state distribution of the chain is $P[X_0 = i] = \frac{1}{4}, I = 0, 1, 2, 3$ Find :

    (i) $P(X_1 = 2/X_0 = 1)$;

    (ii) $P(X_2 = 1/X_1 = 2)$;

    (iii) $P(X_2 = 1, X_1 = 2/X_0 = 1)$;

    (iv) $P(X_2 = 1, X_1 = 2, X_0 = 1)$; and

    (v) $P(X_3 = 3, X_2 = 1, X_1 = 2, X_0 = 1)$.

21. Consider the Markov chain with state space $S = \{0, 1, 2\}$ having transition probability matrix,

    $P = \begin{bmatrix} 0 & 2/3 & 1/3 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/2 & 0 \end{bmatrix}$.

    (i) Examine the chain is irreducible or not ?

    (ii) Define mean recurrence time for the state j.

    (iii) Calculate mean recurrence time for the state 0.

    (iv) Identify the nature of states ?

(1 × 11 = 11 marks)

C 20687 (Pages : 3) Name.......................................

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

SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022

(CBCSS—UG)

Statistics

STA 6B 12—OPERATION RESEARCH AND STATISTICAL QUALITY CONTROL

(2019 Admissions)

Time : Two Hours and a Half Maximum : 80 Marks

Use of calculator and statistical table 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 Linear Programming Problem.
2. Explain optimum solution and feasible solution.
3. Define Decision variables and objective function of LPP.
4. Define primal and dual problem of LPP.
5. Point out the purpose of slack and surplus variables in a simplex procedure ?
6. Define Assignment Problem.
7. Explain the degeneracy in Transportation Problem ?
8. Define the term Statistical Quality Control.
9. Distinguish between process control and product control.
10. Explain control chart.
11. Differentiate between producer's risk and consumer's risk.
12. Explain natural tolerance limits and specification limits.
13. Define acceptance sampling plan.
14. What is single sampling plan ?
15. Explain the terms i) ASN ; and ii) AOQ.

(10 × 3 = 30 marks)

Turn over

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. Explain the graphical method of solving LPP.

17. Define Transportation problem. Show that Transportation problem is a particular case of LPP.

18. Prove that 'dual of the dual is primal'.

19. A company ships truckloads of grains from three sources to four mills. The supply demand together with unit transportation per truckloads are given below. The objective is to minimize the total cost. Obtain the initial basic feasible solution by North West Corner Rule :

Source \ Mill	1	2	3	4	Supply
1	10	2	20	11	15
2	12	7	7	20	25
3	4	14	16	18	10
Demand	5	15	15	15	

20. Distinguish between chance cause of variation and assignable cause of variation in a production process with examples.

21. Write a short note on revised control chart.

22. Write a short note on c-chart.

23. Explain Double sampling plan.

(5 × 6 = 30 marks)

Section C (Essay Type Questions)

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

24. Explain the steps of simplex algorithm for solving LPP.

25. Four different jobs can be done on four different machines. The matrix below gives the cost in rupees of producing job i on machine j :

	M_1	M_2	M_3	M_4
J_1	42	35	28	21
J_2	30	25	20	15
J_3	30	25	30	15
J_4	24	20	16	12

How should jobs be assigned to the various machines in order to minimize the total cost involved.

26. 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.

27. Explain the construction of X-bar chart.

(2 × 10 = 20 marks)

C 20685 (Pages : 2) Name.....................................

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

SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022

(CBCSS—UG)

Statistics

STA 6B 10—DESIGN OF EXPERIMENTS

(2019 Admissions)

Time : Two Hours and a Half Maximum : 80 Marks

Use of calculator and Statistical table are permitted.

Section A

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

1. What is meant by linear estimation ?
2. What do you mean by fixed effects model ?
3. How do you define a linear hypothesis ?
4. What do you mean by the statement 'treatment effects are significant' in ANOVA ?
5. What is meant by covariate in ANCOVA ?
6. Explain 'Uniformity trial'.
7. Write down the ANOVA table of a CRD.
8. What is the degrees of freedom associated to error of a RBD with 4 treatments in 'r' replicates.
9. What is the efficiency of RBD over CRD ?
10. What are the null and alternative hypotheses stated in LSD ?
11. What do you mean by row efficiency of LSD over RBD ?
12. Describe Graeco Latin square design with an example.
13. What do you mean by partially balanced incomplete block design ?
14. Which are the two types of effects measured in a factorial experiment ?
15. How many factors are there in a 2^3 factorial experiment ? Explain.

(10 × 3 = 30 marks)

Turn over

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. State and prove the necessary and sufficient condition for the estimability of a linear parametric function
17. What is meant by BLUE ? Explain the procedure to obtain it.
18. What do you understand by 'analysis of covariance' ? Illustrate with suitable examples.
19. Describe a CRD. Write the model for the data from such an experiment and state the advantages of CRD.
20. How do you estimate two missing observations in RBD ? Explain.
21. Define Latin square design. How do you split up the total sum of squares into components for this design ? Give the analysis of variance table.
22. Describe the factorial method of experimentation.
23. Define BIBD. State the important relations among the parameters of a BIBD.

(5 × 6 = 30 marks)

Section C (Essay Type Questions)

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

24. Explain the basic principles of experimental design.
25. Describe a method of analysing RBD with 2 factors A and B at p and q levels respectively.
26. Explain 2^2 factorial experiment and obtain its ANOVA table :

Source of Variation	S.S	d.f	M.S.S	F
Columns	—	5	—	—
Rows	4.20	—	—	—
Treatments	—	—	2.43	—
Error	—	—	0.65	—
Total	39.65	—		

If the columns represent schools, the rows represent classes, treatments are methods of teaching mathematics and the observations (yields) are scores out of 100, test the hypothesis that the treatment effects are equal to zero.

(2 × 10 = 20 marks)

C 20684 (Pages : 2) Name.......................................

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

SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022

(CBCSS—UG)

Statistics

STA 6B 09—TIME SERIES AND INDEX NUMBERS

(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 Seasonal variation.
2. Describe multiplicative model in time series.
3. What is Gini's Coefficient ?
4. Describe Lorenz Curve.
5. What are the methods of measuring trend ?
6. Explain Simple aggregate method of constructing index numbers.
7. Write down the uses of index numbers.
8. Explain Paache's Index number.
9. Define Factor reversal test.
10. Write any two properties of lognormal distribution.
11. Define Likert scale.
12. Define consumer price index number.
13. Define Deflating.
14. Define Pareto distribution.
15. Write down the limitations of scales.

(10 × 3 = 30 marks)

Turn over

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. How to measure seasonal variation using simple averages ?

17. Explain fitting of Pareto's law.

18. Describe Fishers index Number. Prove that it termed as ideal index number.

19. Explain growth curves. How growth curves used for measuring trend ?

20. Explain Base shifting and splicing of index numbers.

21. Explain cyclic variation.

22. Explain classification of index numbers.

23. Explain Semantic differential scale and Guttman Scale with example.

(5 × 6 = 30 marks)

Section C (Essay Type Questions)

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

24. What are different components of time series ? Explain with an example.

25. Define Pareto distribution. Explain its uses and applications.

26. Describe Link relative method. Explain its merits and demerits.

27. Describe Likert scale. Explain the advantages and limitations of scales in attitude measurements.

(2 × 10 = 20 marks)

C 20260 (Pages : 3) Name..................................

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

SIXTH SEMESTER (CUCBCSS–UG) DEGREE EXAMINATION, MARCH 2022

Statistics

STS 6E 03—RELIABILITY THEORY

(2014 to 2018 Admissions)

Time : Three Hours Maximum Marks : 80

Part A

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

1. ———— is one that consists of n components and functions as long as at least k of the component work.
   - (a) n-out-of-n system.
   - (b) n-out-of-k system.
   - (c) k-out-of-n system.
   - (d) None of these.
2. A system φ is said to be relevant iff ————.
   - (a) Every Ω_i is relevant to the system.
   - (b) Every Ω_i need not be relevant to the system.
   - (c) Any one of Ω_i is relevant to the system.
   - (d) None of these.
3. The structure function of a coherent system satisfies :
   - (a) $\varphi(0, \dots, 0) = 1, \varphi(1, \dots, 1) = 0$.
   - (b) $\varphi(0, \dots, 0) = 0, \varphi(1, \dots, 1) = 0$.
   - (c) $\varphi(0, \dots, 0) = 1, \varphi(1, \dots, 1) = 1$.
   - (d) $\varphi(0, \dots, 0) = 0, \varphi(1, \dots, 1) = 1$.
4. The reliability function ———— from one to zero as the value of x increases.
   - (a) Constant.
   - (b) Increases.
   - (c) Decreases.
   - (d) None of these.
5. A cut set is called minimal if ————.
6. Systems that do not require that all of its components must be working for the system to be working are called ————.
7. If a random variable, x, is exponentially distributed, then the reciprocal of x, $y = 1/x$ follows ————.

True or False :

8. $F'(t) = -R'(t)$.
9. The system reliability is the expected value of the structure function.
10. The mean, variance and failure rate are equal to λ for Poisson distribution.

(10 × 1 = 10 marks)

Part B

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

11. A system consists of five independent components in series, each having a reliability of 0.97. What is the reliability of the system ?
12. Define coherent system.
13. Define 1-out-of-n:F system.
14. Define path vector.
15. Define mean residual life function.
16. State equivalence of Birnbaum's structural and Reliability importance.
17. Find exponential hazard function.

(7 × 2 = 14 marks)

Part C

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

18. In series system, if $X_i \sim \exp(\theta_i)$ find its hazard function for the failure time of the system and MTBF.
19. Prove that for a coherent parallel system, sup V_s < sup V_t for every s and t of S such that $s < t$.
20. Consider the system with independent components which lifetimes Y_i have exponential distribution. The reliability of the component C_i at time y is for $i = 1, 2, \ldots n$ given by the formula $S_i(y) = P(Y_i > y) = e^{-\frac{y}{\lambda}}$ for $y > 0, \lambda > 0$ find the reliability of series system and parallel system.
21. Describe the importance of Poisson distribution in reliability theory. Show that if the number of failures in an interval $(o, t]$ is Poisson, the component life time has the exponential reliability function.
22. Given the hazard function, $h(x) = 2x$, derive the reliability function and the probability density function.

(3 × 4 = 12 marks)

Part D

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

23. Let φ be a coherent system. If A and B are coherent modules of the system φ such that A\B, B\A, and A ∩ B are non-empty, then show that A\B, B\A and A ∪ B are incresing modules of the system φ.

24. Explain Reliability block diagram. Represent them as series, parallel, series-parallel and parallel series system.

25. Explain the method of the Abraham Algorithm for Disjoint sum form for $\varphi(x)$.

26. Describe independent components, and Association of Random Variables.

27. Explain IFR and DFR with the help of examples.

28. Consider an item that has a mean time to fail of 150 hours that is exponentially distributed. Find the probability of surviving through the interval 0 to 20 hours and the interval 100 to 120 hours.

(4 × 6 = 24 marks)

Part E

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

29. The dual structure $\phi^D(x)$ to a given structure $\phi(x)$ is defined by,

$$\phi^D(x) = 1 - \phi(1-x)$$

Where $(1-x) = (1-x_1, 1-x_2, \ldots 1-x_n)$.

  (a) Show that the dual structure of k out of n structure is a $(n-k+1)$ out of n structure.

  (b) Show that the minimal cut sets for ϕ are minimal path sets for ϕ^D and vice versa.

30. Let φ be a structure of a coherent system S, show that

  (a) $\prod_{i=1}^{n} x_i \le \varphi(x) \le \bigcup_{i=1}^{n} x_i$.

  (b) $\varphi(x \wedge y) \le \varphi(x) \wedge \varphi(y)$.

  (c) $\varphi(x \vee y) \ge \varphi(x) \vee \varphi(y)$.

31. (a) Explain the concepts of Poisson distribution.

  (b) Derive expression for reliability function R(*f*) of a reliability system in terms of failure rate.

32. Find :

  (a) Exponential mean time to failure.

  (b) Exponential reliability function.

  (c) Exponential Failure Rate Function.

(2 × 10 = 20 marks)

C 20259 (Pages : 3) Name.................................

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

SIXTH SEMESTER (CUCBCSS–UG) DEGREE EXAMINATION, MARCH 2022

Statistics

STS 6E 02—STOCHASTIC MODELLING

(2014 to 2018 Admissions)

Time : Three Hours Maximum Marks : 80

Section A

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

1. Probability generating function of Bernoulli distribution is ———.
2. If P(*s*) be the pgf of a random variable X, then the pgf os 2X is ———.
3. A state *j* is transient if and only if ———.
4. A stochastic process with independent increment is ———.
5. The period of state *j* is defined as ———.
6. Chapman-Kolmogorov equation of a markov chain is ———.

Choose the correct answer :

7. An absorbing state of a Markov chain is one in which the probability of :
   - (i) Moving into that state is 0.
   - (ii) Moving into that state is 1.
   - (iii) Moving out of that state is 0.
   - (iv) Moving out of that state is 1.
8. If two states of Markov chain are accessible from other, then they are :
   - (i) Communicating states.
   - (ii) Transient states.
   - (iii) Absorbing states.
   - (iv) Periodic states.
9. Poisson process is a stochastic process with :
   - (i) Discrete state space and discrete time.
   - (ii) Continuous state space and continuous time.
   - (iii) Continuous state space and discrete time.
   - (iv) Discrete state space and continuous time.
10. A persistent state of Markov chain is said to be null persistent if its mean recurrence time is :
    - (i) Finite.
    - (ii) Infinite.
    - (iii) Zero.
    - (iv) One.

($10 \times 1 = 10$ marks)

Turn over

Section B

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

11. Define Stochastic process with an example.
12. Consider a stochastic process $\{X(t), t \in T\}$ with $X(t) = A_1 + A_2 t$, where A_1 and A_2 are independent random variable with $E(A_i) = a_i$ and $V(a_i) = \sigma_i^2$. Examine whether the process is stationary or not.
13. What is Markov chain ? Explain.
14. Describe transition probability matrix.
15. Derive the pgf of binomial distribution.
16. Define Brownian motion process.
17. Let X be random variable with pgf P(s). Find the pgf of Y = $cX + d$ where c and d are constants.

(7 × 2 = 14 marks)

Section C

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

18. Establish the relation between $p_{jk}^{(n)}$ and $f_{jk}^{(n)}$ as, $p_{jk}^{(n)} = \sum_{r=0}^{n} f_{jk}^{(r)} p_{kk}^{(n-r)}, n = 1, 2, 3 \ldots.$
19. Explain persistent state and transient state of a Markov chain.
20. Explain absorbing state of a Markov chain with suitable illustrations.
21. Describe Poisson process with suitable example.
22. What is state space of a stochastic process ? Explain different types of state spaces.

(3 × 4 = 12 marks)

Section D

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

23. How do you classify the state of a Markov chain ? Explain.
24. State and prove additive property of Poisson process.
25. Explain ergodic state in a Markov chain with suitable illustrations.
26. Find the period of states of Markov chain having transition probability matrix

$$\begin{bmatrix} 0 & 1/2 & 1/2 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix}.$$

27. Let $\{X_n, n \geq 0\}$ be a Markov chain with states 0, 1, 2 and transition probability matrix

$$P = \begin{bmatrix} 3/4 & 1/4 & 0 \\ 1/4 & 1/2 & 1/4 \\ 0 & 3/4 & 1/4 \end{bmatrix}$$ and initial distribution $P[X_0 = 1] = \frac{i}{3}, i = 0, 1, 2.$ Compute :

(i) $P[X_2 = 2, X_1 = 1 / X_0 = 2]$.

(ii) $P[X_0 = 2, X_1 = 1, X_2 = 2, X_3 = 1]$.

28. Show that a state j is recurrent if and only if $\sum_{n=1}^{\infty} p_{jj}^{(n)} = \infty$.

(4 × 6 = 24 marks)

Section E

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

29. Consider a Markov chain with state space S = {1, 2, 3, 4} having *tpm* $\begin{bmatrix} \frac{1}{3} & \frac{2}{3} & 0 & 0 \\ 1 & 0 & 0 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} & 0 \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} \end{bmatrix}$. Classify the Markov chain and its states.

30. State and prove Chapman Kolmogorov equations.

31. If X_1 and X_2 are iid random variable with pdf $P[X = k] = \frac{(e^a - 1)^{-1} a^k}{k!}, k = 1, 2, 3 \ldots$ Find the pgf of $Y = X_1 + X_2$ and hence obtain E(Y).

32. Write short notes on the following :—

(i) Markov chain.

(ii) Transition probability.

(iii) Weak and strict stationary stochastic processes.

(2 × 10 = 20 marks)

C 20256 (Pages : 2) Name.......................................

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

SIXTH SEMESTER (CUCBCSS–UG) DEGREE EXAMINATION, MARCH 2022

Statistics

STS 6B 13—REGRESSION ANALYSIS

(2014 to 2018 Admissions)

Time : Three Hours Maximum : 120 Marks

I. Answer *all* questions :

1 Explain r^2 in terms of Total Sum of Squares and Residual Sum of Squares.

2 Write the test statistic for testing intercept $\beta_2 = 0$ in a simple linear regression model.

3 Name any *two* test for Normality of residuals.

4 Define Power of test.

5 The two regression lines for the variables X and Y intersect at the point ————.

6 What do you mean by binary variable ?

7 Define a linear regression model.

8 What is conditional expectation function or population regression function ?

9 What is explained variation in regression analysis ?

10 The relationship between correlation coefficient (r) and regression coefficients b_{xy} and b_{xy} of two variables X and Y is given by ————.

(10 × 1½ = 15 marks)

II. Give short answers to the following questions :

11 Define co-efficient of determination.

12 What are the assumptions of general linear regression model ?

13 Explain least square method of estimation.

14 Explain the terms : (i) Stochastic error and (ii) residual.

15 Explain the use of normal probability plot.

16 Explain errors in hypothesis testing.

17 Define multi-collinearity in multiple regression models.

(7 × 3 = 21 marks)

III. Answer any *three* questions :

18 What are the properties of OLS estimators under normality assumption ?

19 Consider the model $Y = X\beta + e$, $E(e) = 0$, $V(e) = \sigma^2 I$. Obtain the unbiased estimator of error variance

20 Briefly explain Logistic regression models.

21 Suggest a method for estimation of polynomial models.

22 Obtain the expression for Residual Sum of Squares in a linear regression model.

(3 × 6 = 18 marks)

IV. Answer any *four* questions :

23 Write short note on probability model for binary response variable.

24 Obtain maximum likelihood estimators for a logistic regression model.

25 Explain the properties and uses of coefficient of determination.

26 What are normal equations ? Obtain normal equations for simple linear regression.

27 Explain the procedure of testing the significance of regression model.

28 Write down the ANOVA table for simple regression and explain each source of variation.

(4 × 9 = 36 marks)

V. Write essays on any *two* of the following :

29 State the assumptions in general linear regression model. Explain the consequences on OLS estimators when assumptions are violated.

30 State and prove Gauss- Markov theorem.

31 Define Poisson regression models. Explain methods of estimation of its parameters.

32 Explain maximum likelihood estimation of two variable regression model. Compare ML estimators with OLS estimators.

(2 × 15 = 30 marks)

C 20255 (Pages : 3) Name.................................

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

SIXTH SEMESTER (CUCBCSS–UG) DEGREE EXAMINATION, MARCH 2022

Statistics

STS 6B 12—POPULATION STUDIES AND ACTUARIAL SCIENCE

(2014 to 2018 Admissions)

Time : Three Hours Maximum : 120 Marks

Section A

Answer **all** *questions in* **one word.**
Each question carries 1.5 *mark*.

1. The number of immigrants minus the number of emigrants is the ——— to the population.
2. The ——— is the number of deaths in a period, per 1000 of the average population in the period.
3. The stable population become stationary population if :

   (i) $r > 0$; (ii) $r = 0$; (iii) $r < 0$; (iv) $r \neq 0$.
4. ——— means something bad happens.
5. $q_x =$

   (i) $\frac{l_{x+1}}{l_x}$; (ii) $\frac{d_x}{l_x}$; (iii) $\frac{l_x}{d_x}$; (iv) None of the above.
6. Vital statistics mainly concerned with :

   (i) birth : (ii) death ; (iii) marriage ; (iv) all the above.
7. The registration of births, deaths and marriages are :

   (i) a fancy of society ; (ii) a part of medical research ; (iii) a legal document ; (iv) all the above.
8. Life table has also been named as :

   (i) survival table ; (ii) life expectancy table ; (iii) mortality table ; (iv) all the above.
9. ——— is obtained on adding annual age specific fertility rate.
10. The relation between $e_x T_x, l_x$ is given by $e_x =$ ———.

    (i) $T_x . l_x$; (ii) $\frac{T_x}{l_x}$; (iii) $\frac{l_x}{T_x}$; (iv) $T_x + l_x$.

Section B

Answer **all** *questions in* **one sentence** *each.*
Each question carries 3 marks.

11. What is meant by abridged life table ?
12. Define force of mortality.
13. What do you mean by Insurance ?
14. Define hazard function.
15. Distinguish between insurer and insured.
16. Show that $p_x = \frac{e_x}{1 + e_{x+1}}$.
17. Distinguish between stable and stationary population.

(7 × 3 = 21 marks)

Section C (Paragraph Questions)

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

18. Give the definition of age specific fertility rate and explain merit and demerits of it.
19. Prove $e^x = \sum_{n=1}^{\infty} \frac{l_{x+n}}{l_x}$.
20. Distinguish between curate expectation and complete expectation of life.
21. What are the advantages of insurance to society.
22. Explain the Reed-Merrel's method for constructing abridged life table.

(3 × 6 = 18 marks)

Section D (Short Essay Questions)

Answer any **four** *questions.*
Each question carries 9 marks.

23. Define vital statistics, what are the uses of vital statistics.
24. Show that the central mortality rate, $m_x = \frac{2q_x}{2 - q_x}$.
25. What are the sources of vital statistics in India. Explain it.
26. Define standardised death rate and also expalin direct method and indirect method of standardisation.

27. Compute the crude and standardised death rates of the two populations A and B, regarding A as standard population, from the following data :—

Age Group (years)	A		B	
	Population	Deaths	Population	Deaths
Under 10	20000	600	12000	372
10—20	12000	240	30000	660
20—40	50000	1250	62000	1612
40—60	30000	1050	15000	525
Above 60	10000	500	3000	180

28. Fill in the blanks in a portion of life table given below :

Age in years	l_x	d_x	p_x	q_x	L_x	T_x	e_x^0
4	95000	500	?	?	?	4850300	?
5	?	400	?	?	?	?	?

(4 × 9 = 36 marks)

Section E (Essay Questions)

Answer any **two** *questions.*
Each question carries 15 *marks.*

29. Discuss the important fertility and mortality rates.
30. Explain the chief characteristics of an ideally insurable loss exposure.
31. What is a Insurance ? What are the principles of insurance ?
32. Discuss the cost and benefits of insurance to society.

(2 × 15 = 30 marks)

C 20254 (Pages : 3) Name.......................................

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

SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MARCH 2022

Statistics

STS 6B 11—DESIGN OF EXPERIMENTS

(2014 to 2018 Admissions)

Time : Three Hours Maximum : 120 Marks

Section A

Answer all **ten** *questions.*
Each question carries 1.5 *mark.*

1. State Guas Markoff theorem.
2. What are the principles of experimentation ?
3. What do you mean by Orthogonal data ?
4. Mention the situation in which ANCOVA is used.
5. Define experimental unit.
6. What do you mean by degrees of freedom ?
7. Write down the Yate's order of treatment combinations of a 2^3 factorial experiment.
8. What are the limitations of LSD ?
9. State the mathematical model used in analysis of variance for a two way classification.
10. Define random effect model.

(10 × 1.5 = 15 marks)

Section B

Answer all **seven** *questions.*
Each question carries 3 *marks.*

11. What do you mean by Estimability of a function.
12. What is randomized block design ?
13. What are symmetrical and asymmetrical factorials ?

14. If there are two missing values in a randomized block design with 4 blocks and 5 traetments, then what will be the error degrees of freedom ?

15. Explain mixed effect model.

16. What is the difference between 'variability within classes' and 'variability between classes'.

17. Explain Randomization.

(7 × 3 = 21 marks)

Section C

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

18. Describe the concept of factorial experiment.

19. Find the efficiency of RBD over CRD.

20. Explain simple effect in 2^2 factorial experiment.

21. Explain Linear estimation.

22. Discuss the advantages and disadvantages of CRD.

(3 × 6 = 18 marks)

Section D

Answer any **four** *questions.*
Each question carries 9 *marks.*

23. What is missing plot technique ? Explain the methods of estimating one missing observation.

24. Explain the methodology of CRD.

25. Construct anova table for a randomized block design.

26. What do you mean by main effects and interaction effects in a factorial experiment ? Explain.

27. Discuss about the fundamental principles of experimental designes.

28. Derive the expression for one missing observation in RBD.

(4 × 9 = 36 marks)

Section E

Answer any **two** *questions.*
Each question carries 15 *marks.*

29. Derive the analysis of variance of LSD.

30. Discuss the analysis of randomized block design with two missing observations.

31. Give the method of calculating sum of squares for factorial experiments in general. Also give anova table for a 2^3 design.

32. Given the following data obtained from a completely randomized design with four treatments, analyse the given data and draw conclusion about the equality of treatment effects. $\left(\text{Tabled value of } F_{0.05(3,10)} = 3.71\right)$.

Treatments			
T_1	T_2	T_3	T_4
20.9	23.7	13.2	5.8
12.4	14.4	10.2	6.1
10.1	9.0	5.1	4.8
4.2			1.5

(2 × 15 = 30 marks)

C 20253 (Pages : 3) Name.......................................

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

SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MARCH 2022

Statistics

STS 6B 10—TIME SERIES AND INDEX NUMBERS

(2014 to 2018 Admissions)

Time : Three Hours Maximum : 120 Marks

I. Answer *all* questions :

1 Define Time series. Give an example.

2 Oscillatory t ype of movements in a time series with period of oscillation more Than one year is called ————.

3 Geometric mean of Laspeyer's and Paasche's index number is ————.

4 Define base period.

5 What is a price relative ?

6 The line obtained by the method of least square is known as the ————.

7 Define Pareto distribution.

8 Define Likert scale of attitude measurement.

9 What is Gini's coefficient ?

10 What do you mean by direct measurement of attitude measurement ?

(10 × 1.5 = 15 marks)

II. Give short answer to the following questions :

11 What is index number ? Define price index number.

12 What is deflating of index number ?

13 Explain the method of moving average of measuring trend.

14 Write down different uses of index numbers.

15 Define lognormal distribution.

Turn over

16 Write any two limitations of scales in attitude measurement.

17 Define Lorenz curve.

(7 × 3 = 21 marks)

III. Answer any *three* questions :

18 Explain additive and multiplicative of time series analysis. Indicating the Components.

19 What is Cost of living index number ? Write different uses of cost of living Index number.

20 Explain ratio to trend method of measuring seasonal indices.

21 What do you mean by 'line of equal distribution' in income modeling ?

22 Explain Guttman scale of attitude measurement.

(3 × 6 = 18 marks)

IV. Answer any *four* questions :

23 Test whether Fisher's index number satisfies both time reversal and factor reversal test.

24 Explain cost of living index number. Write different methods of constructing Cost of living index number.

25 What is time series ? Write the components of time series

26 Find the mean and variance of Pareto distribution.

27 Explain the semantic differential scale of attitude measurement.

28 Explain Chain base index method. Describe the advantages and limitations of Chain base index method.

(4 × 9 = 36 marks)

V. Write essays on any *two* of the following :

29 From the following data find Fisher's index number and show that the time reversal test and factor reversal test satisfied by it :

Commodity	Base year		Current year	
	Price	Quantity	Price	Quantity
A	6	50	10	56
B	2	100	2	120
C	4	60	6	60
D	10	30	12	24
E	8	40	12	36

30 From the following data calculate trend by the method of least square :

Year	1991	1992	1993	1994	1995	1996	1997
Profits (Rs.'000)	300	700	600	800	900	700	1000

31 Define attitude measurement. Describe scaling of Attitude measurement. What are the different types of scaling of attitude measurement ?

32 Explain the method of fitting Pareto's law.

(2 × 15 = 30 marks)