Reg. No. : ....

Name : ....

Sixth Semester B.Sc. Degree Examination, March 2021

First Degree Programme under CBCSS

Statistics

Elective Course

ST 1661.2 : STOCHASTIC PROCESSES

(2018 Admission Regular)

Time : 3 Hours   Max. Marks : 80

SECTION – A

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

1. Define a Stochastic Process.

2. When do you say the state space of a Stochastic Process is discrete?

3. Which type of random variables have the probability generating function? How it gets the name?

4. When do you say a Markov Chain is irreducible?

5. State the Ergodic theorem.

6. What is a Transition Probability Matrix (TPM) said to be doubly stochastic?

7. Define a time-dependent Poisson process.

8. If the arrival process is Poisson. What is the distribution of the inter arrival times?

9. Define a stochastic process with independent increments.

10. What is a time series data?

(10 × 1 = 10 Marks)

SECTION – B

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

11. If X and Y are independent Poisson random variables with same parameter λ, then what is the distribution of $X + Y$?

12. Examine whether $P(s) = \dfrac{2}{1+s}; |s| < 1$ is a probability generating function.

13. Define independence of two random variables.

14. Define a Markov Process.

15. When do you say two states of a Markov Chain are communicative?

16. Define the stationary distribution of a Markov Chain.

17. Derive the Chapman-Kolmogorov equations.

18. Distinguish between a recurrent state and a transient state of a Markov Chain.

19. Define an irreducible Markov Chain.

20. What are the postulates of a Poisson Process?

21. Define stationarity in Stochastic Processes.

22. What do you mean by the order of an autoregressive model in time series?

23. Define autocorrelation. What is its significance?

24. Define a branching process with example.

25. Define the probability of extinction in a branching process.

26. How do you classify a Galton-Watson branching process according to the value of the mean of the offspring distribution?

(8 × 2 = 16 Marks)

SECTION – C

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

27. Define class property. Show that recurrence is a class property.

28. Find the Probability Generating function of a Binomial (n, p) distribution.

29. If the joint probability density function of X and Y is

$$f(x,y) = \begin{cases} 2y + x - 3x^2y & ; 0 \le x, y \le 1 \\ 0, & \text{otherwise} \end{cases}$$

Then,

(a) find the marginal densities of X and Y, and

(b) check the independence of X and Y

30. If X_1 and X_2 are independent random variables with respective Probability Generating functions $G_1(s)$ and $G_2(s), |s| < 1$, find the Probability Generating function of $X_1 + X_2$.

31. Show that for an irreducible Markov Chain, the stationary distribution if exists is unique.

32. Consider a system that alternates between the two states 0(ON) and 1(OFF) that is checked at discrete time points. If the system is OFF at one time point, the probability that is has switched to ON at next time point is p' and if it is ON, the probability that it is switched to OFF is 'q'. Describe the system as a Markov Chain and write the transition probability matrix.

33. Find the stationary distribution of the ON-OFF system described in question 32.

34. When do you say a state is periodic or aperiodic?

35. Explain the compound Poisson random variable. Give an example of a compound Poisson process.

36. Explain Trend and seasonal variation in a time series data.

37. Distinguish between weakly and strongly stationary Stochastic Processes.

38. Describe an Autoregressive(1) (AR(1)) model.

(6 × 4 = 24 Marks)

L – 1673

SECTION – D

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

39. Let X be a random variable with Probability Generating Function $G_X(s) = \frac{s}{5}(2 + 3s^2)$. Find the distribution of X.

40. Discuss the various classifications of Stochastic Processes with appropriate examples.

41. Consider a Markov chain with states $0,1,2,....$ and such that $P_{i,i+1} = p_i = 1 - P_{i,i-1}$, where $p_0 = 1$. Find a necessary and sufficient condition for the chain to be positive recurrent. Also compute the limiting probabilities in this case.

42. A Markov Chain defined with state space $S = \{1,2,3,4,5\}$ has the following transition probability matrix P. Find

    (a) all closed classes,

    (b) irreducible classes,

    (c) recurrent and

    (d) transient states.

$$P = \begin{array}{c} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \left[\begin{array}{ccccc} 0.2 & 0.2 & 0.2 & 0.2 & 0.2 \\ 0 & 0.3 & 0.3 & 0.2 & 0.2 \\ 0 & 0 & 0.3 & 0.3 & 0.4 \\ 0 & 0 & 0 & 0.4 & 0.6 \\ 0 & 0 & 0 & 0.6 & 0.4 \end{array}\right] \end{array}$$

43. Explain the computational procedure to obtain the stationary distribution of an irreducible Markov Chain. Also show that if a stationary distribution exists, then it is unique.

44. Let $\{Z_0 = 1, Z_1, Z_2, ...\}$ be a Branching process with family size Y having a Geometric (1/4) distribution. Find the probability of ultimate extinction and comment on it.

(2 × 15 = 30 Marks)

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Sixth Semester B.Sc. Degree Examination, March 2021

First Degree Programme Under CBCSS

Statistics

Core Course – X

ST 1642 – APPLIED STATISTICS

(2018 Admission Regular)

Time : 3 Hours　　　　　　　　　　　　　　　　　　　　Max. Marks : 80

SECTION – A

Answer all questions. Each question carries 1 mark.

1. What is the fill form of MOSPI?

2. Give any two functions of NSSO.

3. Year to year indices in the chain base method are called:——————.

4. If the new series is connected with old series, the series is known as ——————.

5. Consumer price index is also known as ——————.

6. The geometric mean of Laspeyre's and Paasche's price indices is also known as ——————.

7. Periodic changes in a business time series are called ——————.

8. Moving averages remove —————— and —————— variations.

9. Given the trend equation $\hat{Y} = 108 + 2.28\ X$ with origin 1980 and yearly data given from 1980 to 1992, monthly trend equation is ——————.

10. Link relatives for calculating seasonal indices are converted into ——————.

(10 × 1 = 10 Marks)

P.T.O.

SECTION – B

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

11. What do you mean by additive model and multiplicative model in time series?

12. Define secular trend of a time series.

13. Give a graphical method of obtaining trend of a time series.

14. List out at least the important activities of CSO.

15. What are the different methods to identify trend in time series?

16. What are the uses of Crop forecast?

17. What is official statistics?

18. What is meant by de-seasonalisation of data?

19. Define an index number.

20. What is a chain base index number?

21. What is quantity relative?

22. Give the formula for Marshall Edgeworth index number?

23. Explain Simple aggregative method.

24. Mention the demerits of Paasche's index number.

25. What are the various methods used for measuring cyclical variations?

26. List out the factors which causes for seasonal fluctuations in a time series.

(8 × 2 = 16 Marks)

SECTION – C

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

27. Write a note on cyclic variations in time series analysis.

28. Describe the ratio to moving average and the ratio trend methods of estimating seasonal indices. Compare the two methods.

29. Explain the method of fitting Quadratic trend and exponential trend to a time series.

30. Why Fisher's index number known as ideal Index Number?

31. Explain the terms (a) link relatives and (b) chain relatives.

32. What are the differences between fixed base and chain base methods?

33. What are the main steps in construction of cost of living index numbers?

34. Explain the meaning of upward bias and downward bias with reference to Lasperey's and Paasche's price indices.

35. Distinguish between Weighted aggregative index and Weighted average of relatives.

36. What are the advantageous and disadvantages of the method of least squares?

37. What are the functions of Directorate of Economics and Statistics (DES).

38. What are the main activities of National Statistical Systems Training Academy (NSSTA)?

(6 × 4 = 24 Marks)

SECTION – D

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

39. Describe main features of the statistical system in India.

40. Prepare price and quantity index numbers for 1983 with 1982 as base year from the following data using Fisher's method. With reference to the above, prove how the time and factor reversal tests are satisfied by Fisher's formula.

Commodity	1982		1983	
	Price	Quantity	Price	Quantity
A	5	6	6.6	7
B	7.75	5	8.8	10
C	9.63	4	7.75	6
D	12.5	9	12.75	9

L – 1665

41. Work out the centered 4 yearly moving average for the following data:

Year	Tonnage of goods carried	Year	Tonnage of goods carried
1990	2204	1996	2904
1991	2500	1997	3098
1992	2360	1998	3172
1993	2680	1999	2952
1994	2424	2000	3248
1995	2634	2001	3172

42. In a certain industry, the production of a certain commodity (in thousand tons) during the years 1994-2004 is given in the following table:

Year	Production
1994	66.6
1995	84.6
1996	88.6
1997	78
1998	96.8
1999	105.2
2000	93.2
2001	111.6
2002	88.3
2003	117
2004	115.2

Fit a straight line trend to the data. Obtain the trend values and estimate the production in the year 2005.

43. Explain consumer price index numbers and what are the methods used for the construction of cost of living index number. Write some of the limitations of index numbers.

44. Explain the major problems while constructing index numbers.

(2 x 15 = 30 Marks)

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Sixth Semester B.Sc. Degree Examination, March 2021

First Degree Programme under CBCSS

Statistics

Core Course IX

ST 1641 : DESIGN OF EXPERIMENTS AND VITAL STATISTICS

(2018 Admission Regular)

Time : 3 Hours   Max. Marks : 80

SECTION – A

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

1. Define Analysis of variance.

2. What axe the assumptions in Analysis of variance?

3. What are the basic principles of experimentation?

4. If the experimental units are homogeneous, which design do you prefer?

5. What is a Randomized Block Design?

6. What do you mean by factorial experiments?

7. Define vital statistics.

8. What is crude death rate?

9. What do you mean by Radix?

10. Define General Fertility Rate.

<div align="right">(10 x 1 = 10 Marks)</div>

SECTION – B

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

11. What are the assumptions on experimental errors?

12. When do you call an experimental design a randomized one?

13. Give the statistical model for a CRD with one observation per cell.

14. Explain the advantages of RBD over CRD.

15. Discuss a Latin Square Design.

16. Explain the layout of a 4 x 4 Greaco-Latin Square Design with Greek letters $\alpha, \beta, \gamma, \delta$ and Latin letters A,B,C and D.

17. What is interaction effect in a factorial model?

18. What is confounding?

19. What are symmetrical and asymmetrical factorials?

20. What are the sources of population data?

21. What are the important population estimation methods?

22. In what sense the specific death rates are better than CDR?

23. Which mortality measure is most sensitive Justify?

24. What is the need for standardizing death rates?

25. What is a life table?

26. Name the different measures of population growth.

<div align="right">(8 x 2 = 16 Marks)</div>

SECTION – C

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

27. Discuss the technique of Analysis of variance for two way classification.

28. What are the merits and demerits of a CRD?

29. Discuss the statistical model for Randomized Block Design with one observation per experimental unit.

30. How can data with a single missing value of a $k \times k$ Latin square design be analyzed?

31. Give the expression for the relative efficiency of a LSD of order k over a RBD.

32. Write the set of orthogonal contrasts for main effects and interactions in a 2^2 factorial experiment.

33. What is the purpose sewed by the Sampling Registration System(SRS) in respect of vital statistics?

34. What is the difference between curate (curtailed) expectation and complete expectation of life?

35. Distinguish between a stable and a stationary population.

36. What are the various uses of Life tables?

37. Discuss the term Cental Mortality Rate.

38. Define Net Reproduction Rate. Comment on the values of it.

(6 × 4 = 24 Marks)

SECTION – D

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

39. Describe the analysis of a CRD and sketch the ANOVA table.

40. Discuss the ANOVA of a LSD of order k.

41. Explain the Yates' method of analysis for a 2^n factorial experiment.

42. Discuss the different methods of collecting vital statistics.

43. Describe the methods of standardization of mortality rates.

44. Explain the structure and columns of a complete life table.

(2 × 15 = 30 Marks)

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Sixth Semester B.Sc. Degree Examination, March 2021

First Degree Programme under CBCSS

Statistics

Core Course : ST 1643 – OPERATIONS RESEARCH AND STATISTICAL QUALITY CONTROL

(2018 Admission Regular)

Time : 3 Hours   Max. Marks : 80

Instructions : Statistical tables and calculator are allowed.

SECTION – A

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

1.   Define slack variables.

2.   Define infeasible solution.

3.   When do we say that a basic feasible solution is degenerate?

4.   What is meant by a redundant constraint?

5.   Write any one use of OC curve.

6.   Define quality in terms of variability.

7.   Write any two methods for statistical quality control.

8. What is meant by an attribute?

9. Write the distribution based on which the statistical principle of p chart are underlying

10. Write the average sample number of single sampling plan.

SECTION – B

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

11. Define objective function and constraints in linear programming problem.

12. Write any two advantages of linear Programming problem.

13. What is travelling salesman problem?·

14. Define artificial variable and surplus variable, in a LPP.

15. What is meant by assignment problem?

16. Define basic feasible solution.

17. Write the dual of the LPP:

Minimize $\quad Z = x_1 - 3x_2 - 2x_3$

Subject to $\quad 3x_1 - x_2 + 2x_3 \le 7;$

$2x_1 - 4x_2 \ge 12;$

$-4x_1 + 3x_2 + 8x_3 = 10$ and

$x_1, x_2 \ge 0,\ x_3$ is unrestricted in sign.

18. List the dimensions of quality.

19. Define specification limit.

20. Define statistical process control

21. Write the control limits of X bar chart when the parameter values are known

22. How do we choose rational subgroups?

23. Compute the average outgoing quality of a large lot with fraction of defective 0.015, sentenced using single sampling plan, when the probability of acceptance 0.960.

24. Distinguish between producer's risk and consumer's risk.

25. Define LTPD.

26. Distinguish between ATI and ASN.

(8 × 2 = 16 Marks)

SECTION – C

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

27. Solve the following LPP using graphical method.

    Maximize $Z = -x_1 + 2x_2$

    subject to $x_1 - x_2 \leq -1,$

                    $-0.5x_1 + x_2 \leq 2$ and $x_1, x_2 \geq 0.$

28. Outline North-West corner method.

29. Prove that the dual of the dual is primal.

30. Briefly describe simplex method for solving a LPP.

31. Explain Big M method.

32. Distinguish between chance causes and assignable causes of variation.

33. Describe a control chart.

34. Discuss the applications of statistical quality control techniques in industry.

35. Number of defects in 20 pieces of cloth each of 100 meters length is given by:
    1, 3, 2, 1, 6, 4, 3, 7, 10, 2, 3, 6, 4, 3, 2, 1, 4, 6, 5, 2. Draw suitable control chart
    for number of defects and examine whether the process is in control or not.

36. Discuss the construction and applications of u chart.

37. Compute the probability of acceptance of a single sampling plan with acceptance
    number 2 when the sample size is 100 and lot fraction defective 0.01.

38. Define acceptance sampling. Write down its advantages.

(6 × 4 = 24 Marks)

SECTION – D

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

39. Use two phase simplex method to solve the LPP:

    Minimise $Z = 3x_1 + 2x_2$

    subject to $2x_1 + x_2 \geq 4$;

    $x_1 + 7x_2 \geq 7$; and $x_1, x_2 \geq 0$.

40. Five men are available to do five different jobs. From past records, the time (in hours) that each man takes to do each job is known and is given in the following table. How should the jobs be assigned, one per employee, so as to minimize the total man-hours?

Employees

		I	II	III	IV	V
	A	10	5	13	15	16
Jobs	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

41. Explain Transportation problem. Discuss Vogel's approximation method and least cost method for finding the initial feasible solution of a transportation problem.

42. Construct control chart of mean and range for the following data and comment on the state of control.

Sample No.	1	2	3	4	5	6	7	8	9	10	11	12
	42	46	66	36	57	77	87	45	45	66	87	66
	64	53	81	87	99	89	56	78	78	55	57	120
	44	75	34	60	46	56	39	34	98	48	77	33
Sample Values	75	89	4	79	77	48	121	98	39	88	55	55
	86	44	75	66	44	40	56	65	65	64	97	66

$(A_2 = 0.577, D_3 = 0, D_4 = 2.115)$

43. (a) Explain the construction of p chart and np chart.

(b) The number of nonconforming switches in samples of size 150 are given below. Construct a control chart for fraction of nonconforming using this data. Does the process appear to be in control?

Sample number	No. of non-conforming switches	Sample number	No. of non-conforming switches
1	6	11	7
2	4	12	13
3	4	13	0
4	1	14	9
5	3	15	5
6	7	16	1
7	8	17	4
8	10	18	5
9	5	19	7
10	2	20	12

44. Explain single sampling and double sampling plans. Derive the OC function of double sampling plan.

(2 × 15 = 30 Marks)