Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
Autonomous
Course Structure for M.Sc. Statistics (2022 Pattern)
(With effect from Academic Year 2023-2024)

Name of the Programme   : **M.Sc. Statistics**

Program Code   : **PSST**

Class   : **M.Sc. Part – II**

Semester   : **III**

Paper Code	Title of Paper	No. of Credits
PSST231	Asymptotic Inference	4
PSST232	Design and Analysis of Experiments	4
PSST233	Time Series Analysis	4
PSST234 (A)	Data Mining	
	Or	4
PSST234 (B)	Design and Analysis of Clinical Trials	
PSST235	Practical Paper -V	4
PSST-236	Practical Paper -VI	4

Name of the Programme   : **M.Sc. Statistics**

Program Code   : **PSST**

Class   : **M.Sc. Part – II**

Semester   : **IV**

Paper Code	Title of Paper	No. of Credits
PSST241	Stochastic Processes	4
PSST242	Statistical Process Control	4
PSST243	Survival Analysis	4
PSST244 (A)	Actuarial Statistics	
	Or	4
PSST244 (B)	Optimization Techniques	
PSST245	Practical Paper-VII	4
PSST246	Project	4

Program Outcomes (POs) for M.Sc Programme

PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the discipline that forms a part of a postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PO3	**Social competence:** Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise way and help reach conclusions in group settings.
PO4	**Research-related skills and Scientific temper :** Infer scientific literature, build a sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PO5	**Trans-disciplinary knowledge:** Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Perform independently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

SYLLABUS (CBCS) FOR M.Sc. Statistics
(With effect from Academic Year 2023-2024)

Name of the Programme　　**:** M.Sc. Statistics
Program Code　　**:** PSST
Class　　**:** M.Sc. Part – II
Semester　　**:** IV
Course Name　　**:** Stochastic Processes
Course Code　　**:** PSST241
No. of lectures　　**:** 60
Credit　　**:** 4 credits

A) Learning objectives:

1. To define and describe stochastic processes, including their characteristics and key differences from deterministic processes.

2. To understand the difference between various types of stochastic processes.

3. To analyze and model discrete-time Markov chains, including calculating transition probabilities, classifying states, and predicting long-term behavior.

4. To gain proficiency in continuous-time processes like Poisson processes and Brownian motion, understanding their characteristics and applications.

5. Able to apply stochastic processes to practical problems in fields such as finance, engineering, and biology, and develop the ability to select appropriate models for specific applications.

B) Learning Outcomes:

Students will be able to:

1) develop a deep understanding of what stochastic processes are, including their definitions, characteristics, and mathematical representations.

2) understand stationary processes and its properties.

3) develop problem-solving skills of stochastic processes theory to practical problems.

4) explore the ethical implications of using stochastic processes in various fields.

5) perform stochastic simulations.

6) learn statistical packages for modeling and analyzing stochastic processes.

7) learn about continuous-time stochastic processes, including the Poisson process, Brownian motion, Wiener process and Renewal process.

TOPICS/CONTENTS:

Unit- 1 (15 L)

Introduction to stochastic processes, classification of stochastic processes according to states space and time, Markov property, Markov Chains (MC), finite MC, transition probabilities, initial distribution, Chapman Kolmogorov equation, n-step transition probabilities, Transition Probability Matrix (T.P.M.), Classification of states: Communicating states, first return probability, probability of ever return Classification of states, as persistent and transient states. Decomposition of state space, closed set of states, irreducible set of states, irreducible MC, periodicity of M.C. aperiodic M.C. ergodic M. C, absorption probabilities, random walk, gambler's ruin chain with absorbing , reflecting and elastic barrier, etc. probability of ruin cases (i) adversary is infinitely rich (ii) stakes are doubled or halved ,expected gain, expected duration of the game.

Unite -2 (15 L)

Long-Run proportions and limiting probabilities, relation with mean recurrence time, stationary distribution. Branching Chain: BGW branching process, offspring distribution, mean and variance, generating function for probability of ultimate extinction, n^{th} generation size and related recurrence relations.

Unit- 3 (15 L)

Poisson process: Postulates and properties of Poisson process, probability distribution of N(t) the number of occurrences of the event in (0,t], Poisson process and probability distribution of inter arrival time, generalizations of Poisson process: pure birth process: Yule Furry process, Birth immigration process. Birth and death process: (i) immigration-emigration process, (ii) linear growth process, (iii) linear growth with immigration, (iv) immigration death process. (v) Pure death process.

Unit -4 (15 L)

Continuous Time Markov Chains (CTMC), Markov processes with continuous state space: Introduction to Brownian motion and its properties, Wiener process. Renewal process: renewal process in continuous time, renewal function and renewal density, renewal equation, stopping time: Wald's equation, elementary renewal theorem and its applications.

References:

1) Medhi J. (1982), Stochastic processes (Wiley Eastern).

2) Ross, S. (1996). Stochastic processes (John Wiley).

3) Ross, S. (2000). Introduction to probability models, 7th edition (Academic Press).

4) Hoel , P.G.,Port, S.C. ,Stone, C.J. (1972) : Introduction to stochastic processes.

5) Bhat, B.R. (2000). stochastic models: Analysis and applications (New Age International).

6) Adke, S.R., Manjunath, S.M. (1984). An introduction to finite Markov processes (WileyEastern).

7) Taylor, H N and Karlin, S. (1984). An introduction to stochastic modeling(AcademicPress).

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1		2	2				
CO2	2	3	1	3					
CO3	2	3		2					
CO4	2	1		3					
CO5	2	3		3					
CO6	3	3		3	2				
CO7	3	3		3					

Weight: 1 - Partially related   2 - Moderately Related   3 - Strongly related

SYLLABUS (CBCS) FOR M.Sc. Statistics
(With effect from Academic Year 2023-2024)

Name of the Programme : M.Sc. Statistics
Program Code : PSST
Class : M.Sc. Part – II
Semester : IV
Course Name : Statistical Process Control
Course Code : PSST242
No. of lectures : 60
Credit : 4 credits

A) Learning objectives:

1. The main objective of this course is to understand the philosophy and basic concepts of quality improvement.

2. Students should able to understand and interpret the basic concepts and usage of Six Sigma.

3. Students should able to use the methods of statistical process control.

4. Students will learn to apply statistical process control (SPC) system which provide a statistical signal when assignable causes of variation are present.

5. Students will learn to decrease costs related to scrap materials, reworking, and inspections

B) Learning outcomes:

Students will be able to

1. Describe the DMAIC processes (define measure, analyze, improve, and control).
2. Perform analysis of process capability and measurement system capability.
3. Demonstrate the ability to design, use, and interpret synthetic control chart and non-parametric control chart.
4. Determine the "short" term stability and capability of a process.

TOPICS/CONTENTS:

Unit- 1 (10 L)

a) **Total quality Management**: meaning and dimensions of quality, Quality improvement, Quality Philosophy, Introduction to TQM, Six sigma, DMAIC, and other extension of TQM, quality systems, The ISO 9000 and other Quality systems. Deming's PDCA cycle for

continuous improvements and its applications.

b) Concepts of stable industrial processes, Systematic variation, random variation, variation within and between subgroups, estimation of process parameters,

Unit- 2   (15 L)

a) **Control Chart:** Revision of control charts for attributes, S^2 chart, X -S chart with subgroup size (i) fixed, (ii) variable. Equivalence between control chart and testing of hypothesis problem. Operating characteristic (OC curve) of control chart. Average run length (ARL). Probability of false alarm, probability of catching shift in parameter. Comparison of control chart using ARL and OC curve. Patterns on control charts with justification and its effect on probability of false alarm. An application of control charts situations other than manufacturing.

b) **Attribute control charts**: Revision of control charts for attributes, OC curve for P chart and C chart. Determination sample size for P chart by various criteria (i) probability of catching at least 0.5 (ii) to get LCL >0 (iii) To have at least some defectives in sample with given confidence coefficient. (iv) Minimizing ATS () chart and OC Curve, U chart, Demerit control chart for number of defects. Nelsons control chart for low defect counts. General ideas of economic designing of control charts. Duncan's model for the economic control chart.

Unit- 3   (20 L)

a) **CUSUM chart:**

Chart statistic (c_i^+, c_i^-)and chart parameters(k,h), construction and working of tabular CUSUM chart for mean and variance, Statement of hypotheses. Estimation of shift in mean of process, fast initial response or head start feature, Sigmund's approximation for ARL and determination of chart parameters.CUSUM chart for subgroup size n>1, comparison between Shewhart chart and CUSUM chart V mask procedure.

b) **EWMA chart**:

Chart statistic its expectation and variance. Choice of chart parameters (L). Construction and working of EWMA chart for mean and variance. EWMA chart for subgroup size n>1, Comparison of Shewhart control charts with CUSUM charts. Simulation of ARL ().

c) **Process capability**: Different Process capability and performance indices C_p, C_{pk}, C_{pm} and relation between capability indices. Connection between proportion of defectives (DPPM)

and C_p. Interval estimation of mean given $C_{pm} \geq 1$. Estimation and confidence intervals of estimators of C_p and C_{pk} Testing of hypothesis about C_p.

Unit- 4 (15L)

a) **Other control charts**

   (i) Synthetic control chart: Concept of run length, probability distribution of run length Confirming run length (CRL) chart for attributes, Synthetic control chart, computations of chart parameters for given ARL (0), Zero State Performance, Steady state performance, Computations of ARL (), ATS ()., Comparison of with Shewhart control chart and CUSUM charts.

   (ii) Non-parametric control chart: Concept, construction of non-parametric chart using sign test.

   (iii) A distribution-free Shewhart Quality Control Chart Based on Singed-Rank.

   (iv) Control charts for auto correlated observations: Need, constructions of control chart for residuals after fitting first order auto correlated model.

b) **Hoteling T^2 Chart**: Testing multivariate normality, Hoteling T^2 multivariate control chart for mean vector when (i) dispersion matrix is (i) known (ii) unknown ARL (0), ARL (δ). Control chart for dispersion matrix when mean vector is (i) known (ii) unknown. T^2 control chart when subgroup size n=1

References:

1) Bourke P.D. (1991) Detecting shifts in fraction non – confirming using run length chart with 100% inspection. Journal of Quality Technology 23 (3) 225-230

2) Besterfield, D. H.Besterfield – Michana, c, Besterfield,G.H. Besterfield-Sace, M(2001) Total Quality Management ; Pearson Education(Singapore) Pte. Ltd. India 2nd Edition.

3) Logotheris, N. (1992) Managing Total Quality; Prentic Hall of India.

4) Montgomery ,D.C. (1985) Introduction to Statistical Quality Control (Wiley)

5) Oakland J.S. (1989) Total Quality Management: Butterworth – Heinemann.

6) Raid W. Amin **a** Marion R. Reynolds Jr. b; Bakir Saad c: Nonparametric quality control charts based on the sign statistic: Communications in Statistics - Theory and Methods Vol. 24(6), 1995.

7) Bakir S. T. : A distribution-free Shewhart Quality Control Chart Based on Singed-Ranks, Quality Engineering, Vol. 16(4), 613-623

8) Wu, Yeu and Spedding (2001) A synthetic control chart for detecting fraction non confirming increases JQT Vol. 33 (1), 104-111.

Course Outcomes			Programme Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2	2	2	1	2	3	-	1
CO2	3	2	1	2	1	2	2	-	1
CO3	3	2	2	3	1	2	3	-	1
CO4	2	1	1	2	1	2	2	-	1

Weight: 1 - Partially related   2 - Moderately Related   3 - Strongly related

SYLLABUS (CBCS) FOR M.Sc. Statistics
(With effect from Academic Year 2023-2024)

Name of the Programme : M.Sc. Statistics
Program Code : PSST
Class : M.Sc. Part – II
Semester : IV
Course Name : Survival Analysis
Course Code : PSST243
No. of lectures : 60
Credit : 4 credits

A) Learning objectives:

1. Student should be able to decide the type of censoring and truncation that is the basis for given survival data.

2. Student should be able to estimate survival functions using parametric and non-parametric methods.

3. Student should be able to compare survival functions of two or more populations.

4. Student should be able to use software for survival analysis.

B) Learning outcomes:

After completing this paper, the student will be able to:

1. Identify applications with time to event outcomes.

2. Construct a life table using the actuarial approach.

3. Construct a life table using the Kaplan-Meier approach.

4. Perform and interpret the log rank test.

5. Compute and interpret a hazard ratio.

6. Interpret coefficients in Cox proportional hazards regression analysis.

TOPICS/CONTENTS:
Unit- 1 (15 L)

Survival data, meaning of censoring, concepts of time, order and random censoring (left and right), survival function, density function, hazard function (rate), cumulative hazard rate, mean residual life function, percentile residual life function, Equilibrium distribution function. Exponential distribution and it's no ageing properties: Lack of memory property, constant failure rate, Cauchy-function equation, constant mean residual life function ,TTT transform, identity

function as a TTT transform, aging classes - IFR, IFRA, NBU, NBUE, DMRL, HNBUE and their duals, and inter relationship among these classes. Bathtub Failure rate, IFRA closure property, bound on reliability function of an IFRA distribution.

Unite -2 (15 L)

Life distributions - Exponential Gamma, Weibull, Lognormal, Pareto, linear Failure rate, Makeham family, Lehman families (proportional hazard rate family), spacing, normalized spacing and results of an exponential distribution based on normalized spacing. Parametric inference for complete data: a) Exponential distribution: Point estimation of parameter of exponential distribution and Fisher information, exact and asymptotic Confidence Intervals for λ, obtaining minimal sufficient and consistent estimator of λ, and Graphical method for checking exponetiality of data. b) Weibull: Obtaining MLE of scale and shape parameter of Weibull distribution and sample information matrix. c) Gamma: Obtaining MLE of scale and shape parameter of Gamma distribution and sample information matrix. d) Lognormal: Obtaining MLE of parameter μ and σ, Confidence Interval for μ and σ.

Unit- 3 (15 L)

Parametric inference for censored data: 1) Type I censoring: Exponential distribution 2) Type II censoring: Exponential, gamma, Lognormal 3) Random censoring: Exponential, Lehman family, Weibull distribution, Non-Parametric estimation of survival Function a) For complete data: Non parametric estimator of distribution function and survival function, distribution of emperical survival function, confidence band for survival function (by Using Kolmogorov - Smirnov statistics) b) For censored data: Actuarial estimator of survival Function, Estimator of variance of actuarial estimator (Greenwoods formula), product limit estimator and its variance, redistribution to right algorithm.

Unit -4 (15 L)

Test for Exponetiality: Estimable function of degree r, Kernel, symmetric Kernel, U-statistic, variance of U- Statistic, one sample U-Statistic theorem, Hollander and Proschan Test, Test for exponetiality against positive ageing based n sample spacing, Analytical test for exponentiality against NBUE, Deshpande's Test, Two sample U- statistic theorem, Wilcoxon and Mann –Whitney test, Gehan's test, Mantel- Haenzel test, Log rank test, Semi-parametric regression for failure rate - Cox's proportional hazards model with one and several covariates.

References:

1) Cox, D.R. and Oakes, D. (1984) Analysis of Survival Data, Chapman and Hall, New York.
2) Deshpande ,J.V, Purohit, S. G.,(2005), Life Time Data :Statistical Models and Methods.
3) Elandt - Johnson, R.E., Johnson N.L. (1980) Survival models and Data Analysis, John Wiley and Sons.
4) Gross A.J. and Clark, V. A. (1975) Survival Distributions: Reliability Applications in the Biomedical Sciences, John Wiley and Sons.
5) Miller, R.G. (1981) Survival Analysis (Wiley).
6) David G. Kleinbaum and Mitchel Klein, (2020) Survival Analysis A Self- Learning Text, Third Edition, (Springer).

Course Outcomes				Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	2	-	-	-	-	2
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	1	3	3	1	-	2	-
CO4	3	3	3	-	1	1	1	1	1
CO5	3	3	3	3	2	3	3	3	3
CO6	2	2	1	2	1	1	-	-	-

Weight: 1 - Partially related   2 - Moderately Related   3 - Strongly related

Syllabus(CBCS) for M.Sc. Statistics
(With effect from Academic Year 2023-2024)

Name of the Programme	:	M.Sc. Statistics
Program Code	:	PSST
Class	:	M.Sc. Part – II
Semester	:	IV
Course Name	:	Actuarial Statistics
Course Code	:	PSST244(A)
No. of lectures	:	60
Credit	:	4 credits

A) Learning objectives:

1. The main objective of this course is to learn and understand various concepts involved in Actuarial Statistics.
2. Provide students with a foundational understanding of actuarial science and its role in risk assessment, management, and financial planning.
3. Cover the principles of life insurance and annuities, including mortality tables, premium calculations, and reserve valuation.
4. Apply appropriate modelling techniques for lifetime random variables involved in the field of Insurance.
5. Apply the fundamental theories of actuarial statistics as they apply in life insurance, endowment insurance, n-year term life insurance.
6. Provide an overview of actuarial models used in pricing insurance products, such as the single premium, net premium, and gross premium.
7. Provide real-world case studies and practical exercises that allow students to apply actuarial principles and techniques to solve practical problems.
8. Prepare students for actuarial exams by covering the syllabus content for relevant actuarial societies.

B) Learning Outcomes:

By the end of the course, students should be able to:

1. identify and analyse consequences of events involving risk and uncertainty.
2. calculate survival function, curtate future lifetime, force of mortality.
3. calculate various payments from life tables using principle of equivalence, net premiums, prospective and retrospective reserve.
4. understand the principles of risk management and how they apply to actuarial practice.

5. gain insights into the insurance and financial industries, including current trends, challenges, and opportunities.

6. apply actuarial techniques to real-world scenarios and case studies.

7. explore ethical considerations and responsibilities in the actuarial profession.

TOPICS/CONTENTS:

UNIT-1 (15L)

Introduction to Insurance Business, insurance and utility theory, time-until-death random variable, survival function, distribution function, density functions and force of mortality and curtate-future lifetime random variable its probability mass function, deferred probabilities, all these functions in terms of international actuarial notation. Analytical laws of mortality such as Gompertz' law and Makeham's law, select and ultimate life table.

UNIT-2 (15L)

Principles of compound interest: Nominal and effective rates of interest and force of interest and discount, compound interest, accumulation factor, continuous compounding.

Life insurance: Insurance payable at the moment of death and at the end of the year of death, level benefit insurance, whole life insurance, endowment insurance, deferred insurance and varying benefit insurance, recursion equation, Actuarial present value of the benefit. Net single premiums.

UNIT-3 (15L)

Annuity contracts, annuity certain, discrete annuity, m-thly annuity, continuous annuity, deferred annuity, present values and accumulated values of these annuities. Continuous life annuity, discrete life annuity such as whole life annuity, temporary life annuity, n-year certain and life annuity, life annuities with m-thly payments. Present value random variables for these annuity payments, their means and variances, Actuarial present value of the annuity.

UNIT-4 (15L)

Loss at issue random variable, various principles to decide net premiums for insurance products and annuity schemes defined in unit II and III, fully continuous premiums and fully discrete premiums, true m-thly payment premiums, extended equivalence principle to decide gross

premiums, concept of reserve, prospective and retrospective reserve, fully continuous reserve, fully discrete reserve.

References:

1. Bowers, JR. N.L., Gerber, H.U., Hickman, J.C., Jones, D.A. and Nesbitt, C.J. (1997). Actuarial Mathematics, 2nd Edition, the Society of Actuaries.
2. Deshmukh S.R. (2009). Actuarial Statistics: An Introduction Using R, Universities Press.
3. Actuarial Mathematics, Society of Actuaries, ltasca, lllinois, U.S.A. 2nd Edition (1997).
4. Spurgeon E.T. (1972); Life Contingencies, Cambridge University Press. Neill, A. Life Contingencies, Heinemann.

SYLLABUS (CBCS) FOR M.Sc. Statistics
(With effect from Academic Year 2023-2024)

Name of the Programme : M.Sc. Statistics
Program Code : PSST
Class : M.Sc. Part – II
Semester : IV
Course Name : Optimization Techniques
Course Code : PSST244 (B)
No. of lectures : 60
Credit : 4 credits

A) Learning objectives:

1. The main objective is to understand the mathematical tools that are needed to solve optimization problems.

2. Students should be able to understand discrete event simulation and decision analysis with inclusion of modeling based on random events involving uncertainties.

B) Learning outcomes:

1. Students can identify and develop operational research models from the verbal description of the real system.

2. Students will be able to understand the characteristics of different types of decision-making environments and decision-making approaches.

3. Students can apply optimization techniques to take correct decision.

TOPICS/CONTENTS:

Unit-1   **(12L)**

Linear Programming Problem: Review of simplex algorithm and simplex method, Existence of unbounded solution, optimality conditions, for other related theorems (statement only), artificial variable technique: Two phase and Big-M method, Revised simplex method.

Unit 2   **(12L)**

Duality in LPP: Concept of duality, duality theorems, dual simplex method, duality theory of testing optimality of solution and transshipment problem. Sensitivity analysis: Bellman's optimality principle, changes affecting feasibility and optimality.

Unit 3   **(18L)**

Integer linear programming problem (ILPP): The concept of cutting plane, Gomory's method of cutting plane for all ILPP and mixed ILPP, Branch and Bound method, Nonlinear programming: Kuhn-Tucker conditions of optimality, Quadratic programming, Wolfes, Beales methods, applications of ILPP.

Unit 4   **(18L)**

Dynamic programming: Nature of dynamic programming, deterministic processes, Non-sequential discrete optimization allocation problems, sequential discrete optimization long-term planning problem, multi-stage production processes. Inventory model: Inventory model building, single items inventory control models without shortages, EOQ model with constant rate of demand, with different rate of demand and economic production quantity model when supply is gradual.

References:

1) Bertsekas, D. (1999). *Nonlinear Programming*, 2nd Edn. Athena Scientific.

2) Chong, E. K. P. and Zak, S. (2004). *An Introduction to Optimization*, Wiley.

3) Fletcher, R. (2000). *Practical Methods of Optimization*, Wiley.

4) Hadley, G. (1987). *Linear Programming*. Addison-Wesley.

5) Kambo, N.S. (1991). *Mathematical Programming Techniques*. Affiliated East-West press.

6) Panneerselvam, R. (2012). *Operations Research*, 2nd Edn. Prentice Hall of India.

7) Taha, H.A. (1992). *Operations Research*, 5th ed. Macmillan.

Course Outcomes				Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	3	2	2		-	-
CO2	2	3	2	-	-	-	-	3	-
CO3	3	-	2	3	3	2	-	-	3

Weight: 1 - Partially related   2 - Moderately Related   3 - Strongly related

SYLLABUS (CBCS) FOR M.Sc. Statistics

(With effect from Academic Year 2023-2024)

Name of the Programme : M.Sc. Statistics
Program Code : PSST
Class : M.Sc. Part – II
Semester : IV
Course Name : Statistics Practical – VII
Course Code : PSST245
No. of lectures : 60
Credit : 4 credits

Course Objectives:

1. To introduce students to Markov processes, including discrete-time and continuous-time Markov chains, and to enable them to analyze and model real-world problems using these processes.

2. Students will learn the fundamental properties of stochastic processes, including stationarity, ergodicity, and Markovian properties.

3. Students will learn techniques for analyzing the behavior of stochastic processes, including mean, variance, and higher-order moments.

4. Students will learn concepts of SPC, including control charts, process variation, common cause variation, and special cause variation.

5. Students will learn to analyze and evaluate various types of risks in insurance and financial settings.

6. Students should gain a strong understanding of the fundamental principles of actuarial science, including concepts such as risk, probability, and statistical analysis.

7. Students will Learn how to create parametric models using mathematical equations or statistical methods.

Course Outcomes:

Students should be able to:

CO1. Understand the applications of stochastic processes in modeling real-world phenomena.

CO2. Learn the fundamentals of stochastic calculus, including Ito's lemma and stochastic differential equations (SDEs).

CO3. Analyze and model various types of stochastic processes, including Poisson processes.

CO4. Understanding the principles and techniques of SPC to monitor, control, and improve processes.

CO5. Proficiency in using statistical tools and charts to analyse process variation and make data- driven decisions for quality improvement.

CO6. Acquire knowledge of actuarial mathematics, including probability theory and mathematical modelling.

CO7. Learn about various actuarial models and techniques for risk assessment and management.

Sr. No.	Title of Experiments
1.	Realization of Markov chain and calculation of n-step transition probabilities and limiting distribution in Markov chain.
2.	Realization of Poisson process.
3.	Realization of birth and death process.
4.	CUSUM and EWMA charts.
5.	Process capability analysis for normal data.
6.	Synthetic chart for mean and Multivariate control chart.
7.	Non parametric control chart
8.	Parametric analysis of complete data.
9.	Parametric analysis of censored data.
10.	Computation of Actuarial estimator of survival function and PL –Estimator.
11.	Test for exponentially- I
12.	Test for exponentially- II
13.	Field Visit/ Industrial Visit/ Study Tour (2 Practicals)

Course Outcomes			Programme Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	2	1	1	1	1	1
CO2	3	3	1	2	1	-	1	1	-
CO3	3	3	1	1	2	-	1	-	-
CO4	3	3	2	1	1	1	1	-	1
CO5	3	2	2	1	2	1	-	1	-
CO6	3	2	1	2	1	-	1	-	-
CO7	3	2	1	1	1	1	1	1	1

Weight: 1 - Partially related   2 - Moderately Related   3 - Strongly related

SYLLABUS (CBCS) FOR M.Sc. Statistics
(With effect from Academic Year 2023-2024)

Name of the Programme : M.Sc. Statistics
Program Code : PSST
Class : M.Sc. Part – II
Semester : IV
Course Name : Project
Course Code : PSST246
No. of Lectures : 60
No. of Credits : 4

A) Learning objectives:

The main objective of this course is to

1. develop proficiency in using statistical software packages like R, SPSS, Matlab or Python for data analysis and visualization.

2. acquire skills in data collection, data cleaning, and data transformation.

3. improve the ability to communicate statistical findings effectively through written reports and presentations

4. apply advanced statistical techniques to analyze the research data and draw meaningful conclusions

5. interpret the results of the analysis and discuss their implications in the context of the project questions/objectives.

6. present the project findings in a clear and concise manner, both in written form and through oral presentations.

7. develop the ability to critically evaluate existing statistical literature and research studies in the field.

B) Learning outcomes:

1. Students will be able to gain practical experience in data collection, data cleaning, and data imputation, which are essential skills in statistics, data analytics and data science.

2. Gaining expertise in statistical software packages like R, SAS, or Python and using these tools is valuable for future career opportunities in IT industry and many more filed.

3. MSc project serves as a valuable stepping stone, demonstrating research capabilities.

4. Statistical analysis may provide insights that can inform policy or decision-making in these areas in a specific social issue or problem, such as healthcare, education, or environmental sustainability.

5. MSc projects can identify actionable insights; consider providing recommendations or guidelines for addressing the social issue that were studied.

6. Collaborate with experts from other fields (e.g., biology, economics, psychology, garniture, manufacturing industry) to apply statistical methods to interdisciplinary problems, potentially leading to innovative solutions and insights.

7. Successful MSc projects can open doors to consulting opportunities where students can apply statistical methods to solve practical problems for businesses or organizations.

TOPICS/CONTENTS:

This part of the course consist summary of research articles, data analysis and report in dissertation form.

1. Summary of Research Articles

Students are expected to choose her/his own project topic and read some (not less than 5) articles (exact number of articles will be decided by the supervisor) on a selected topic or theme, summarize and write a comprehensive report and present the summary of the articles.

2. Data Analysis

Students are expected to analyze data pertaining to certain theme using a variety of statistical tools that they have studied so far.

Note:

1. Students have to prepare project report and have to submit one copy for the assessment.

2. Data analysis project can be done in a group (at the most 3 students).

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	3	3			3
CO2	3	3	3	3	2	1			3
CO3	3	3	3	3					
CO4	3	3	3		3				
CO5	3	3	3						
CO6	3	3	3			3			
CO7	3	3	3		3	3			3

Weight: 1 - Partially related   2 - Moderately Related   3 - Strongly related