Chaudhary Charan Singh University, Meerut
DEPARTMENT OF STATISTICS

Date:-09.06.2023

Proceedings of the Meeting of Board of Studies in Statistics
Held on June 09, 2023 In Hybrid mode (Online & Offline)

The following were present:

1. Prof. Hare Krishna, Dean Faculty of Science, Ch. Charan Singh University, Meerut.
2. Prof. Hare Krishna, HOD, Deptt. of Statistics, Ch. Charan Singh University, Meerut.(Convener I)
3. Prof. Bhupendra Singh, Deptt. of Statistics, Ch. Charan Singh University, Meerut.
4. Dr. Alka Chaudhary, Principal, Kanohar Lal College, Meerut. .(Convener II)
5. Dr. Pradeep Kumar Tyagi, DPBS, Bulandshahr.
6. Dr. R.B.Singh, D.N. College, Meerut.
7. Prof. Sanjeev Kumar Tomar, Deptt. of Statistics, Banaras Hindu University, Varanasi.
8. Prof. D.K.Garg, Deptt. of Statistics, Punjabi University, Patiala, Punjab.
9. Prof. O.K. Belwal, Deptt. of Statistics, HNB Garwal University, Srinagar (UK)
10. Dr. Abha Chandra (Retd.), Meerut College Meerut.
11. Dr. Anil Kumar, Principal Scientist, Indian Agriculture Statistics Research Institute, Delhi.

The Board discussed and finalized the Syllabi for Ph.D. Course Work in Statistics.
The Syllabi are enclosed herewith..

9/6/23
(Prof. Hare Krishna)
HOD & Convener I

CH. CHARAN SINGH UNIVERSITY, MEERUT

Ref.: Committee Cell (BOS-Statistics) 5481
Dated: 06-06-2023

A meeting of the Board of Studies (University Campus & Affiliated Colleges) in the subject of Statistics (Pre Ph.D. Course work) in Chaudhary Charan Singh University Meerut will be held on 09-06-2023 at 4:00 P.M. online and offline in the department of Statistics. Members are requested to kindly attend the meeting.

Members of Board of Studies in Statistics (Pre Ph.D.):-

1. Dean Faculty of Science, C.C.S. University, Meerut.
2. Prof. Hari Krishna, HOD, Deptt. of Statistics, C.C.S. University, Meerut. (Convener-I)
3. Prof. Bhupendra Singh, Deptt. of Statistics, C.C.S. University, Meerut.
4. Dr. Alka Choudhary, Principal, Kanohar Lal College, Meerut. (Convener-II)
5. Dr. Pradeep Kumar Tyagi, DPBS, Bulandshahr.
6. Dr. R. B. Singh, D.N. College, Meerut.
7. Prof. Sanjeev Kumar tomar, Deptt. of Statistics, Banaras Hindu University, Varanasi.
8. Prof. D.K. Garg, Deptt. of Statistics, Punjabi University, Patiala, Punjab.
9. Prof. O.K. Belwal, Deptt. of Statistics, HNB Garhwal University, Srinagar (UK)
10. Dr. Abha Chandra (Retd.), Meerut College, Meerut.
11. Dr. Anil Kumar, Principal Scientist, Indian Agricultural Statistics Research Institute, Delhi.

06/06

Asstt. Registrar
(Comm.Cell)

Copy to:-

1. S.V.C. for kind information of the Hon'ble Vice Chancellor.
2. Steno to the Finance Controller for information of the Finance Officer.
3. H.O.D. concerned/committee cell.
4. Shri Sandeep Aggarwal, SCRIET, to conduct the meeting on Zoom App.

Asstt. Registrar
(Comm.Cell)

DEPARTMENT OF STATISTICS
CH.CHARAN SINGH UNIVERSITYMEERUT

Syllabus for Pre-Ph.D. courses in Statistics

(w.e.f. 2023-2024)

1. DURATION :

The minimum duration of Pre-Ph.D. Course shall be one semester.

2. ELIGIBILITY:

The eligibility for the admission for Ph.D. in Statistics will be as per the Ph.D. degree ordinances, 2022 of C.C.S. University, Meerut.

3. COURSE STRUCTURE:

Each eligible candidate is to pass **three** theory courses out of which one compulsory course will be on

Course I: Research Methodology

This course of Four credits will be common for all faculties and its syllabus will be framed at University level.

There will be **two** other subject related courses of Four credits each, from among the following pool as offered by the coordinator of the Pre-Ph.D. course work.

Course II(a): Statistcal Inference and Statistical distributions

Course II(b): Advanced Bayesian Statistics & Reliability Theory

Course II(c): Survival Analysis

Couse II(d): Emerging Areas of Statistics

Course III: A Four credit Research project based on term paper/ dissertation/ Literature review/ Survey work etc.

Minimum attendance required to become eligible to appear in the course examination for each paper shall be 75%. The relaxation may be provided by the H'ble Vice-Chancellor as per university norms. The passing marks in each course shall be as per PhD ordinances framed by the university. All the courses are of four credits each, to be taught in 60 lectures.

The detailed Syllabi of courses II(a) to (d) are given below.

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Course II(a):

Subject: Statistics		
Course Code: -----	**Course Title:** Statistcal Inference and Statistical distributions	Theory paper Course II(a)

Course Objectives: The main objective of this paper is to

1. Learn the formulation of Hypothesis.
2. Learn the testing of Hypothesis.
3. Study advance level Probability distributions.
4. Study Bivariate and Non- central distributions.

Course Outcomes: At the end of this course, the students should be able to:

CO1. Apply hypothesis testing in decision problems.
CO2. Draw inferences when distribution is unknown.
CO3. Construct distribution free confidence Intervals.
CO4. Fit and use advance distributions.
CO5. Analyses bivariate data.
CO6. Apply Non-central distribution in data analysis.

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 100	Min. Pass Marks:55

Total No. of Lectures-Tutorial (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures (Total sum = 60)
I	**Hypothesis Testing:** Optimum regions and sufficient statistics, similar tests, test with Neyman structure, Randomised tests. Monotonicity, consistency and Invariant properties of the tests. Elements of decision theory, Hypothesis testing as a decision problem. Bayes and Minimax tests.	15
II	**Non Parametric Methods:** Run test for randomness, sign test for location, median, Wilcoxon, Mann-whitney tests and Kolmogorov–Smironov test (with distribution of the test statistics involved) for the two sample problem. Tests for goodness of fit. Distribution free confidence intervals for quantiles and confidence bands for distribution functions.	15
III	**Statistical Distributions:** Detailed Study with Examples and applications of Bivariate Geometric, negative hypergeometric bivariate and multivariate hypergeometric, negative multinomial, Polya-Eggenberger,Inverse Polya-Eggenberger, multivariate	20

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	Polya-Eggenberger. Their ascending and descending factorial moments, Marginal and Conditional distributions, compound and limiting distributions.	
IV	Generalized Beta distribution,Weibull, Pareto, Lindley and Inverse Guassian Distributions, bivariate Beta, bivariate inverted Beta, bivariate Gamma and bivariate F distributions. Non-Central distributions of Beta, Chi-Square, t and F. Doubly non-central t, F and Beta distributions.	10

Teaching Learning Process: Class discussions/ demonstrations, Power point presentations, Class activities/ assignments, Field visits., Internship, etc.

Suggested Readings:

1. Lehmann,E.L : Testing Statistical Hypothesis.
2. Rao,C.R : Linear Statistical Inference & Its Application.
3. Mood,A.M.Graybill, F.A.Boes,D.C : Introduction to the theory of Statistics.
4. Rohtagi,V.K. : An Introduction to Probability Theory and Mathematical Statistics
5. Ghosh, B.K. : Sequential Tests And Sequential Hypothesis.
6. Ferguson, T.S. : Mathematical Statistics- A Decision Theoretic Approach.
7. Gibbons, J.D. : Non-Parametric Methods In Statistics.
8. Goon,A.M.,Gupta,M.K. and Das Gupta,B. : An outline Of Statistical Theory Vol.I
9. Johnston,N.L. and Kotz,S.: Distributions In Statistics.
   (i) Discrete Distributions.
   (ii) Continuous Univeriate Distributions I.
   (iii)Continuous Univeriate Distributions II.
   (iv) Continuous Multivariate Distributions.
10. Wilks, S.S : Mathematical Statistics.

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Course II(b):

Subject: Statistics		
Course Code: -----	**Course Title:** Advanced Bayesian Statistics & Reliability Theory	Theory paper Course II(b)

Course Objectives: The main objective of this paper is to

1. Equip the students with the knowledge of the basic measuring tools and different system configurations.
2. Provide the knowledge of methods of system reliability improvements with their practical aspects.
3. Provide the knowledge and understanding of applying advance Bayesian tools for predicting and analyse the system reliability.
4. Equip the students with the knowledge of Markov chain and Monte Carlo techniques.

Course Outcomes: At the end of this course, the students should be able to:

CO1. Use the techniques of improving and estimating the reliability in day to day real existing engineering systems.

CO2. Apply the Bayesian tools to predict the future outcomes in real life situations such as whether prediction, email spam prediction etc.

CO3. Apply the Bayes technique such as Naïve Bayes classifier to correctly classify a task such as text classification.

CO4. Apply Markov Chain and Monte Carlo techniques in simulation scenarios.

CO5. Calculate reliability, failure rate and mean life time.

CO6. Formulate reliability models by using various failure and repair time distributions.

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 100	Min. Pass Marks:55

Total No. of Lectures-Tutorial (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures (Total sum = 60)
I	**(i)Advanced Bayesian Statistics:-** An outline to Bayesian framework, Types of priors, Methods of obtaining priors, Types of loss functions, Computation of posterior distributions,Bayesian Computation, Bayesian CLT, Classical Monte Carlo Integration, Importance sampling, Accept-reject method(ARM).	15
II	Markov Chain and Monte Carlo (MCMC)-Methodology: Background, Metropolis Algorithm, Detailed Balance Equation, Metropolis-Hastings Algorithm, Gibbs Sampler, Finding the full conditionals, Empirical Bayes, HPD intervals, Codings in R-environment.	15

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III	**(ii) Reliability and Theory:** Failure density, failure rate, reliability and its graphical representation, Pointwise and steady state availabilities, Interval availability and Interval reliability, Mean time to system failure(MSTF). Constant linearly increasing and non-linear increasing hazard models, Normal, gamma, lognormal, trancated normal, Weibull, Pareto and Lindley failure laws, Expressions of reliability and MTSF in series structure, Parallel structure, k-out of n-structure, series parallel structure, parallel series structure and bridge configuration.	15
IV	Various kinds of active redundancies and standby redundancy and their reliability comparison. System preventive maintenance and system repair under different repair disciplines, various types of reparable priority redundant systems. Availability analysis of n-non identical unit series system with constant failure and repair rates by using Markov model. Analysis of two identical and non-identical unit parallel and standby systems with constant failure and constant/general repair rates by using supplementary variable technique and regenerative point technique, n-unit standby system with parallel repairs, two-unit standby systems with slow and imperfect switching devices.	15

Teaching Learning Process: Class discussions/ demonstrations, Power point presentations, Class activities/ assignments, Field visits., Internship, etc.

Suggested Readings:

1. Hogg, MC Kean and Craig : Introduction to Mathematical Statistics, Pearson Prentice Hall
2. Robert, C.P. and Casella : Monte Carlo Statistical methods G. Springer, New york
3. Sheldon M. Ross : Introduction to probability models, Academic Press, New york
4. Balaguruswamy,E. : Reliability Engineering, Tata Mc Graw Hill.
5. Govil A.K. : Reliability Engineering,Tata Mc Graw Hill.
6. Rau, J.G. : Optimization and Probability in Systems Engineering, Van Nostrand Reinnald Company.

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Course II(c):

Subject: Statistics		
Course Code: -----	**Course Title:** Survival Analysis	Theory paper Course II(c)

Course Objectives: The main objective of this paper is to

1. Learn basic concepts of lifetime data analysis.
2. Find Reliability, Characteristics
3. Study various Censoring Schemes.
4. Develop estimation procedures for failure data.

Course Outcomes: At the end of this course, the students should be able to:

CO1. Calculate reliability, failure rate and mean lifetime.
CO2. Fit lifetime distributions to failure data
CO3. Collect incomplete data through various Censoring Schemes.
CO4. Estimate reliability characteristics with Censored data.
CO5. Apply exponential distribution and Weibull distribution in Survival analysis.
CO6. Fit other statistical distribution to failure data.

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 100	Min. Pass Marks:55

Total No. of Lectures-Tutorial (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures (Total sum = 60)
I	**Basic concepts :** Definition Of Reliability function, Failure rate or hazard function, Mean residual life and their relationship, censoring methods, Right and left censoring, Type I and II censoring with and without replacement, Random Censoring Progressive and Hybrid censoring.	12
II	**Censored Samples:** Estimation of Parameters and reliability function in case of Exponential distribution with Type I, Type II Random and Progressive censoring schemes.	18
III	**Some failure time distributions:** One and two parameter exponential, Gamma, Weibull, Normal and Lognormal, Lindley, Geometric distributions, their PDF, CDF, Reliability, Failure rate and Other characteristics used in life time data analysis.	12
IV	**Reliability Estimation Procedures:** Estimation of Parameters and reliability function associated with various life time distributions, Various properties of these estimators, confidence	18

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	intervals for parameters and reliability function. Mixture models: Exponential and Weibull distributions.	

Teaching Learning Process: Class discussions/ demonstrations, Power point presentations, Class activities/ assignments, Field visits., Internship, etc.

Suggested Readings:

1. Sinha, S.K. : Reliability and Life Testing, Wiley Eastern Ltd.,1986.
2. Lawless, J.F. : Statistical Models and Methods for Life Time, Data, Wiley, 1982.
3. Mann,N.,Schafer, E. and Singpurwalla,N. : Methods for Statistical Analysis of Reliability and Life,Data, Wiley,1974.
4. Miller : Survival Analysis, Wiley
5. Nelson : Applied Life Data Analysis
6. Kapoor K.C. & Lamberson L.R. : Reliability In Engineering Design John Wiley and Sons,New York
7. Martz, H.F. and Waller R.A. : "Bayesian Reliability Analysis" John Wiley & Sons.
8. Dimitri, K. : "Reliability & Life Testing Handbook" Prentice Hall, New Jersey.

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Course II(d):

Subject: Statistics		
Course Code: -----	**Course Title:** Emerging Areas of Statistics	Theory paper Course II(d)

Course Objectives: The main objective of this paper is to

1. Learn Advance topics of probability theory and statistical distributions.
2. Know various properties of estimators.
3. Learn to develop estimators.
4. Construct various design of experiment.

Course Outcomes: At the end of this course, the students should be able to:

CO1. Apply various inequalities of probabilities theory.
CO2. Use statistical distribution in data analysis.
CO3. Derive estimators of parameters.
CO4. Formulate and test the hypotheses.
CO5. Apply suitable design to failed experiments.
CO6. Formulate the reliability models to failure time data.

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 100	Min. Pass Marks:55

Total No. of Lectures-Tutorial (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures (Total sum = 60)
I	**Probability Theory:** Random variables, Discrete and Continuous r.v.'s with their distributional Properties, joint, marginal and conditional distributions, Expectations, MGF, PGF and CF. Markov's, Chebychev's, Kolomogorov, Cauchy-schwartz and Jenson's inequalities. Convergence of sequence of r.v.'s, Convergence in distribution, WLLN and SLLN, Central limit Theroms.	12
II	**Statistical Distribution:** Negative binomial, negative Hyper-geometric, Multinomial and Multivariate hypergeometric distributions. Their p.g.f., factorial moments, limiting, marginal and conditional distributions. Non-Central Chi-square, t, F and Beta distributions with their Charteristics.	12
III	**Statistical Inference:** Consistency, unbiasedness, efficiency, sufficiency and completeness, Rao-Blackwell theorm and	

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	Lehmann-Scheffe's theorm, Uniformity minimum variance unbiased estimation. Method of maximum likelihood estimation, Method of Moments, Tests of significance based on Z, t, F and Chi-square statistics.	12
IV	**Design of Experiments:** Analysis of variance and covariance, principles of design of experiment, CRD, RBD and LSD including missing plot techniques, split and strip plot designs, factorial experiments (2^n,3^2,3^3) with confounding, Analysis of BIBD and its properties.	12
V	**Reliability:** Reliability and its utility, performance measures of system with their inter-relations, various failure laws, system and system configurations, types of redundancy with their reliability/availability comparison, concepts of preventive and repair maintenance. Analysis of simple two unit reparable system models with constant failure and repair rates.	12

Teaching Learning Process: Class discussions/ demonstrations, Power point presentations, Class activities/ assignments, Field visits., Internship, etc.

Suggested Readings:

1. Johnson N. L., Kotz, "Continuous Univariate Distributions V-Ist", John Wiley & Sons, New York.
2. Johnson N. L., Kotz, "Continuous Univariate Distributions V-IInd", John Wiley & Sons, New York.
3. Johnson N. L., Kotz, "Discrete Distributions", John Wiley & Sons, New York.
4. Lehmann E.L., "Theory of Point Estimation", John Wiley & Sons, New York.
5. Mood Grabill & Bose, "Introduction to the Theory Of Statistics", Mc-Graw Hill.
6. Das and Giri, "Design of Experiments", Wiley Eastern Ltd., New Delhi.
7. Chocran W.G. and G.M., "Experiment Design", John Wiley & Sons, New York.
8. Kempthorne, O, "The Design and Analysis of Experiment", Wiley Eastern Ltd., New Delhi.
9. Srinath L.S., "Mathematical Theory of Reliability", Affiliated East West Press Pvt. Ltd.
10. Balaguruswamy E., "Reliability Engineering", Tata Mc-Graw Hill Publications, New Delhi.
11. Bhatt B.R., "Modern Probability Theory", Wiley Eastern Ltd., New Delhi.

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