VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE WITH STATISTICS

(MULTIDISCIPLINARY STUDIES)

3-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

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VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE IN MATHEMATICAL & COMPUTER SCIENCE with STATISTICS
(*under CCFUP, 2023*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Math. & Comp. Sc. with Statistics	1st	I	**SEMESTER-I**							
			Major (Disc.-A1)	STSPMJ101	**T: Fundamentals of Statistical Methods; P: Practical** *(To be studied by the students taken Statistics as Discipline-A)*	4	3-0-1	15	60	75
			SEC	SEC01	*To be chosen from SEC-01 of Discipline A/B/C of their Hons. prog.*	3	0-0-3	10	40	50
			AEC	AEC01	Communicative English-1 (*common for all programmes*)	2	2-0-0	10	40	50
			MDC	MDC01	Multidisciplinary Course-1 (*to be chosen from the list*)	3	3-0-0	10	40	50
			VAC	VAC01	VAC-01: ENVS (*common for all programmes*)	4	2-0-2	50	50	100
			Minor (Disc.-C1)	STS MI 01/C1	**T: Fundamentals of Statistical Methods; P: Practical** *(To be studied by the students taken Statistics as Discipline-C)*	4	3-0-1	15	60	75
					Semester-I Total	20				400
		II	**SEMESTER-II**							
			Major (Disc.-B1)		*To be decided* *(Same as like A1 for students taken Statistics as Discipline-B)*	4	3-0-1	15	60	75
			SEC	SEC02	*To be chosen from SEC-02 of Discipline A/B/C of their Hons. prog.*	3	0-0-3	10	40	50
			AEC	AEC02	MIL-1 (*common for all programmes*)	2	2-0-0	10	40	50
			MDC	MDC02	Multidisciplinary Course-02 (*to be chosen from the list*)	3	3-0-0	10	40	50
			VAC	VAC02	VAC-02 (*to be chosen from the list*)	4	4-0-0	10	40	50
			Minor (Disc.-C2)	STS MI 02/C2	**T: Introductory Probability; P: Practical** *(To be studied by the students taken Statistics as Discipline-C)*	4	3-0-1	15	60	75
			Summer Intern.	CS	Community Service	4	0-0-4	-	-	50
					Semester-II Total	24				400
					TOTAL of YEAR-1	44	-	-	-	800

P MJ= Major Programme (Multidisciplinary), MI = Minor, A/B = Choice of Major Discipline; C= Choice of Minor Discipline; SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, VAC = Value Added Course; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language, ENVS = Environmental Studies

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VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE IN MATHEMATICAL & COMPUTER SCIENCE with STATISTICS
(*under CCFUP, 2023*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Math. & Comp. Sc. with Statistics	2nd	III	**SEMESTER-III**							
			Major (Disc.-A2)	STSPMJ202	**T: Introductory probability; P: Practical** *(To be studied by the students taken Statistics as Discipline-A)*	4	3-0-1	15	60	75
			Major (Disc.-A3)	STSPMJ203	**T: Basics of Statistical Inference; P: Practical** *(To be studied by the students taken Statistics as Discipline-A)*	4	3-0-1	15	60	75
			SEC	SEC03	*To be chosen from SEC-03 of Discipline A/B/C of their Hons. prog.*	3	0-0-3	10	40	50
			AEC	AEC02	Communicative English-2 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC03	Multidisciplinary Course-3 (***to be chosen from the list***)	3	3-0-0	10	40	50
			Minor (Disc.-C3)	STS MI 03/C3	**T: Basics of Statistical Inference; P: Practical** *(To be studied by the students taken Statistics as Discipline-C)*	4	3-0-1	15	60	75
					Semester-III Total	20				375
		IV	**SEMESTER-IV**							
			Major (Disc.-B2)		*To be decided* *(Same as like A2 for students taken Statistics as Discipline-B)*	4	3-0-1	15	60	75
			Major (Disc.-B3)		*To be decided* *(Same as like A3 for students taken Statistics as Discipline-B)*	4	3-0-1	15	60	75
			Major (Elect.-1)	STSPMJE 01	**T: Research Methodology; P: Practical**	4	3-0-1	15	60	75
			AEC	AEC02	MIL-2 (***common for all programmes***)	2	2-0-0	10	40	50
			Minor (Disc.-C4)	STS MIN 04/C4	**T: Applications of Statistics; P: Practical** *(To be studied by the students taken Statistics as Discipline-C)*	4	3-0-1	15	60	75
			Summer Intern.	Internship/ Apprenticeship	Internship/Apprenticeship (any Discipline)	4	0-0-4	-	-	50
					Semester-IV Total	22				400
					TOTAL of YEAR-2	42				775

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VIDYASAGAR UNIVERSITY

BACHELOR OF SCIENCE IN MATHEMATICAL & COMPUTER SCIENCE with STATISTICS

(*under CCFUP, 2023*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Math. & Comp. Sc. with Statistics	3rd	V	**SEMESTER-V**							
			Major (Disc.-A4)	STSPMJ04	T: Applications of Statistics; P: Practical *(To be studied by the students taken Statistics as Discipline-A)*	4	3-0-1	15	60	75
			Major (Disc.-A5)	STSPMJ05	T: Monte Carlo Method; P: Practical *(To be studied by the students taken Statistics as Discipline-A)*	4	3-0-1	15	60	75
			Major (Disc.-A6)	STSPMJ306	T: Project work using R and/ or MS-Excel; *(To be studied by the students taken Statistics as Discipline-A)*	4	3-0-1	15	60	75
			Major (Elect.-2)	STSPMJE 302	T: Statistical Quality Control; P: Practical *(To be studied by the students taken Statistics as Discipline-A)*	4	3-0-1	15	60	75
			Minor (Disc.-C5)	STS MI 05/C5	T: Monte Carlo Method; P: Practical *(To be studied by the students taken Statistics as Discipline-C)*	4	3-0-1	15	60	75
					Semester-V Total	20				375
		VI	**SEMESTER-VI**							
			Major (Disc.-B4)		*To be decided (Same as like A4 for students taken Statistics as Discipline-B)*	4	3-0-1	15	60	75
			Major (Disc.-B5)		*To be decided (Same as like A5 for students taken Statistics as Discipline-B)*	4	3-0-1	15	60	75
			Major (Disc.-B6)		*To be decided (Same as like A6 for students taken Statistics as Discipline-B)*	4	3-0-1	15	60	75
			Major (Elect.-3)	STSPMJ(E) 303	T: Econometrics; P: Practical *(To be studied by the students taken Statistics as Discipline-A)*	4	3-0-1	15	60	75
			Minor (Disc.-C6)	STS MI 06/C6	T: Project work using R and/ or MS-Excel; *(To be studied by the students taken Statistics as Discipline-C)*	4	3-0-1	15	60	75
					Semester-VI Total	20				375
					TOTAL of YEAR-3	40				750

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List of Major Courses (MJ)

MJ- A1/B1: Fundamentals of Statistical Methods

MJ- A2/B2: Introductory probability

MJ- A3/B3: Basics of Statistical Inference

MJ- A4/B4: Applications of Statistics

MJ- A5/B5: Monte Carlo Method

MJ- A6/B6: Project work using R and/ or MS-Excel

Elective Courses (MJ(E))

Major (Elect.) – 1: Research Methodology

Major (Elect.) – 2: Statistical Quality Control

Major (Elect.) – 3: Econometrics

Skill Enhancement Courses (SEC)

SEC-1: Statistical Computing using MS Excel

SEC-2: Statistical Computing using C/C++ Programming

SEC-3: Statistical Computing with R

List of Minor Courses (MI)

MI-01/C1: Fundamentals of Statistical Methods

MI-02/C2: Introductory probability

MI-03/C3: Basics of Statistical Inference

MI-04/C4: Applications of Statistics

MI-05/C5: Monte Carlo Method

MI-06/C6: Project work using R and/ or MS-Excel

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MAJOR (MJ)

MJ A1/B1: Fundamentals of Statistical Methods — Credits 04 (FM: 75)

MJ A1/B1T: Fundamentals of Statistical Methods — Credits 03

Course contents:

Unit 1:
Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Frequency distribution, Presentation: tabular and graphic, including histogram and ogives.

Unit 2:
Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis.

Unit 3:
Bivariate data: Definition, scatter diagram, simple correlation, multiple correlation (3 variables only), rank correlation (Spearman). Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

Unit 4:
Theory of attributes, consistency of data, independence and association of attributes, measures of association and contingency table (Case of 2x2 only).

MJ A1/B1P: Fundamentals of Statistical Methods Lab (Practical) — Credits 01

List of Practical

1. Graphical representation of data.
2. Problems based on measures of central tendency.
3. Problems based on measures of dispersion.
4. Problems based on combined mean and variance and coefficient of variation.
5. Problems based on moments, skewness and kurtosis.
6. Fitting of polynomials, exponential curves.
7. Karl Pearson correlation coefficient.
8. Multiple correlations
9. Spearman's rank correlation without ties.
10. Correlation coefficient for a bivariate frequency distribution.
11. Lines of regression, angle between lines and estimated values of variables.
12. Checking consistency of data and finding association among attributes.

Suggested Readings:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I& II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. AndBoes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. Goon A.M., Gupta M.K. and Dasgupta B.: Basic Statistics. The World Press, Kolkata.
5. Chakraborty, Arnab (2016): Probability and Statistics. Sarat Book House.

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MJ A2/B2: Introductory probability **Credits 04 (FM: 75)**

MJ A2/B2T: Introductory probability **Credits 03**

Course contents:

Unit 1:
Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic.

Unit 2:
Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

Unit 3:
Random Variables: Discrete and continuous random variables, p.m.f., p.d.f., c.d.f. Illustrations of random variables and its properties. Expectation, variance, moments and moment generating function.

Unit 4:
Standard probability distributions: Uniform, Binomial, Poisson, Geometric, Rectangular, Normal, Exponential.

MJ A2/B2P: Introductory probability Lab (Practical) **Credits 01**

List of Practical

1. Problems based on area property of normal distribution.
2. To find the ordinate for a given area for normal distribution.
3. Application based problems using normal distribution.
4. Fitting of normal distribution when parameters are given.
5. Fitting of normal distribution when parameters are not given.
6. Problems similar to those in 1 to 5 in case of exponential continuous distributions

Suggested Readings:

1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi
4. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I& II, 8th Edn. The World Press, Kolkata.
5. Chakraborty, Arnab (2016) : Probability and Statistics. Sarat Book House.
6. Ross, S. (2002): A First Course in Probability, Prentice Hall.

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MJ A3/B3: Basics of Statistical Inference **Credits 04 (FM: 75)**

MJ A3/B3T: Basics of Statistical Inference **Credits 03**

Course Contents:

Unit 1

Population and Sample, Parameter and Statistic, Population distribution and Sampling distribution.

Statistical Inference: Point Estimation, Interval Estimation and Testing of Statistical Hypothesis. Four useful distributions for statistical Inference; Normal, χ^2, t and F (Statement of the pdf's & shape of the curves). Estimation of population mean, confidence intervals for the parameters of a normal distribution (one sample and two sample problems).

The basic idea of significance test. Null and alternative hypothesis. Type I& Type II errors, level of significance, concept of p-value. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).

Unit 2

Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi-square test.

Unit 3

Tests for the significance of correlation coefficient. Sign test. Wilcoxon two-sample test.

Unit 4

Analysis of variance, one-way and two-way classification. Brief exposure of three basic principles of design of experiments, Statistical concepts of "treatment", "plot" and "block".

Analysis of completely randomized design, randomized complete block design.

MJ A3/B3P: Basics of Statistical Inference Lab (Practical) **Credits 01**

List of Practical

1. Estimators of population mean.
2. Confidence interval for the parameters of a normal distribution (one sample and two sample problems).
3. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).
4. Chi-square test of proportions.
5. Chi-square tests of association.
6. Chi-square test of goodness-of-fit.
7. Test for correlation coefficient.
8. Sign test for median.
9. Sign test for symmetry.
10. Wilcoxon two-sample test.
11. Analysis of Variance of a one-way classified data
12. Analysis of Variance of a two-way classified data.
13. Analysis of a CRD.
14. Analysis of an RBD.

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Suggested Readings:

1. Giri, P. K., & Banerjee, J: Statistical Tools & Techniques. Academic Publishers
2. Daniel, Wayne W., Bio-statistics (2005): A Foundation for Analysis in the Health Sciences. John Wiley.
3. Goon, A.M., Gupta M.K. & Das Gupta (2005): Fundamentals of statistics, Vol.-I & II.
4. Das, M. N. & Giri, N. C.: Design and analysis of experiments. John Wiley.
5. Dunn, O.J (1977): Basic Statistics: A primer for the Biomedical Sciences. John Wiley.

MJ A4/B4: Applications of Statistics Credits 04 (FM: 75)

MJ A4/B4T: Applications of Statistics Credits 03

Course Contents:

Unit 1

Economic Time Series: Components of time series, Decomposition of time series- Additive and multiplicative model with their merits and demerits, Illustrations of time series.

Measurement of trend by method of free-hand curve, method of semi-averages and method of least squares (linear, quadratic and modified exponential). Measurement of seasonal variations by method of ratio to trend.

Unit 2

Index numbers: Definition, Criteria for a good index number, different types of index numbers. Construction of index numbers of prices and quantities, consumer price index number & wholesale price index number. Index of Industrial Production and rate of inflation. Uses and limitations of index numbers.

Measures of Inequality and Development: Gini's coefficient and Lorenz curve, Human Development Index.

Unit 3

Demographic Methods: Introduction, measurement of population, rates and ratios of vital events. Measurement of mortality: CDR, SDR (w.r.t. Age and sex), IMR, Standardized death rates.

Life (mortality) tables: definition of its main functions and uses. Measurement of fertility and reproduction: CBR, GFR, and TFR. Measurement of population growth: GRR, NRR.

MJ A4/B4P: Applications of Statistics & Official Statistics Lab Credits 01

List of Practical

1. Measurement of trend: Fitting of linear, quadratic trend, exponential curve and plotting of trend values and comparing with given data graphically.
2. Measurement of seasonal indices by Ratio-to-trend method and plotting of trend values and comparing with given data graphically.
3. Construction of price and quantity index numbers by Laspeyre's formula, Paasche's formula, Marshall-Edgeworth's formula, Fisher's Formula. Comparison and interpretation.
4. Construction of Consumer and wholesale price index numbers, fixed base index number and consumer price index number with interpretation.
5. Gini's coefficient, Lorenz curve, Human Development Index.
6. Computation of measures of mortality.
7. Completion of life table.
8. Computation of measures of fertility and population growth

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Suggested Readings:

1. Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency, Calcutta.
2. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II,9th Edition World Press, Kolkata.
3. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, 4th Edition (Reprint), Sultan Chand &Sons

MJ A5/B5: Monte Carlo Method Credits 04 (FM: 75)

MJ A5/B5T: Monte Carlo Method Credits 03

Course Contents:

Unit 1

Using the computer for random number generation (treated as a black box). A brief look at some popular approaches (no mathematical justification needed). Simulating a coin toss, a die roll and a card shuffle.

Unit 2

CDF inversion method. Simulation from standard distributions. Finding probabilities and moments using simulation.

Unit 3

Monte Carlo integration. Basic idea of importance sampling. MCMC not included.

Unit 4

Generating from Binomial and Poisson distributions, and comparing the histograms to the PMFs. Generating from Uniform(0,1) distribution, and applying inverse CDF transforms. Simulating Gaussian distribution using Box-Muller method. Approximating the expectation of a given function of a random variable using simulation. Graphical demonstration of the Law of Large Numbers. Approximating the value of pi by simulating dart throwing.

MJ A5/B5P: Monte Carlo Method Lab Credits 01

List of Practical

1. Random number generation from Binomial distribution.
2. Random number generation from Poisson distribution.
3. Random number generation from Uniform distribution.
4. Simulation of Gaussian distribution using Box-Muller method.
5. Finding probabilities and moments using simulation from standard distributions.

Suggested Readings:

1. Shonkwiler, Ronald W. and Mendivil, Franklin (2009):Explorations in Monte Carlo Methods (Undergraduate Texts in Mathematics)
2. Carsey, Thomas M. and Harden, Jeffrey J. (2014): Monte Carlo Simulation and Resampling Methods for Social Science.

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MJ A6/B6: Project work using R and/ or MS-Excel **Credits 04 (FM: 75)**

Objective: The aim of the course is to initiate students to write and present a statistical report, under the supervision of a faculty, on some area of human interest. The project work will provide hands on training to the students to deal with data emanating from some real-life situation and propel them to dwell on some theory or relate it to some theoretical concepts.

Different statistical concepts using R and/ or MS-Excel to be discussed with the students before the project work:

- Descriptive Statistics: Mean, median, mode, variance, measures of skewness & kurtosis, Correlation coefficient
- Representation of data: By different graphs and tables
- Inferential Statistics: Testing of hypothesis in connection with normal distribution (one sample and two sample problems), Some simple nonparametric tests: Sign test, Wilcoxon two-sample test. Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi-square test.
- Regression Analysis: Handling Simple regression, Multiple regression, Logistic regression
- Analysis of variance: One way and two-way classification

Elective Courses (MJ(E))

MJ (E) 1: Research Methodology **Credits 04 (FM: 75)**

MJ (E) 1T: Research Methodology **Credits 03**

Course Contents:

Unit 1

What is Research? Role of Research in important areas. Characteristics of Scientific Method. Process of research: Stating Hypothesis or Research question, Concepts & Constructs, Units of analysis & characteristics of interest, Independent and Dependent variables, Extraneous or Confounding variables. Measurements and scales of Measurements. Types of research:

Qualitative & Quantitative Research, Longitudinal Research, Survey & Experimental Research.

Unit 2

Survey Methodology and Data Collection, sampling frames and coverage error, non- response.

Unit 3

Review of various techniques for data analysis covered in core statistics papers, techniques of interpretation, precaution in interpretation: Fitting of discrete and continuous distributions, fitting of linear and multiple linear regression models, multiple and partial correlation coefficients. Use of Box plot and Quantile-Quantile plot. Exact tests of the parameters of Binomial, Poisson, Normal and Bivariate Normal distributions. Large sample tests for binomial proportions, Poisson means (single and two independent samples cases) and correlation coefficients.

Unit 4

Develop a questionnaire, collect survey data pertaining to a research problem (such as gender discriminations in private v/s government sector, unemployment rates, removal of subsidy, impact on service class v/s unorganized sectors), questions and answers in surveys, Internal & External validity, interpret the results and draw inferences. Formats and presentations of Reports – an overview.

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MJ (E) 1P: Research Methodology Lab (Practical) **Credits 01**

List of Practical: Using Computer Software (MS-Excel/C/R)

1. Fittings of discrete distributions
2. Fittings of continuous distributions
3. Fittings of simple linear regression model
4. Fittings of multiple linear regression models
5. Exact tests for the parameters of binomial, Poisson, normal and bivariate normal distributions
6. Large sample tests- binomial proportion(s) and Poisson means.
7. Large sample test for correlation coefficient
8. Use of Box plot and Q-Q plot.

Suggested Readings:

1. Kothari, C.R. (2009): Research Methodology: Methods and Techniques, 2nd Revised Edition reprint, New Age International Publishers.
2. Kumar, R (2011): Research Methodology: A Step - by - Step Guide for Beginners, SAGE publications.
3. Mukhopadhyay, P.: Mathematical Statistics.
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I, 8th Edn. The World Press, Kolkata.
5. Rohatgi, V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2nd Edn. (Reprint) John Wiley and Sons.
6. Tukey, J.W.(1977) : Exploratory Data Analysis, Addison-Wesley Publishing Co.
7. Das, N.G. : Statistical methods (Vol-I and II)

MJ (E) 2: Statistical Quality Control **Credits 04 (FM: 75)**

MJ (E) 2T: Statistical Quality Control **Credits 03**

Course Contents:

Unit 1

Quality: Definition, dimensions of quality, historical perspective of quality control and improvements starting from World War II, historical perspective of Quality Gurus and Quality Hall of Fame. Quality system and standards.

Unit 2

Introduction to ISO quality standards, Quality registration. Statistical Process Control - Seven tools of SPC, chance and assignable Causes of quality variation. Statistical Control Charts- Construction and Statistical basis of 3-σ Control charts, Rational Sub-grouping.

Unit 3

Control charts for variables: X-bar & R-chart, X-bar & s-chart. Control charts for attributes: np-chart, p-chart, c-chart and u-chart. Comparison between control charts for variables and control charts for attributes. Analysis of patterns on control chart, estimation of process capability.

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Unit 4

Acceptance sampling plan: Principle of acceptance sampling plans. Single sampling plan their OC, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation, use and interpretation of Dodge and Romig's sampling inspection plan tables. Introduction to Six-Sigma: Overview of Six Sigma. Lean Manufacturing and Total Quality Management (TQM).

MJ (E) 2P: Statistical Quality Control Lab (Practical) **Credits 01**

List of Practical

1. Construction and interpretation of statistical control charts
    a. X-bar & R-chart
    b. X-bar & s-chart
    c. np-chart
    d. p-chart
    e. c-chart
    f. u-chart
2. Single sample inspection plan: Construction and interpretation of OC, AQL, LTPD, ASN, ATI, AOQ, AOQL curves
3. Calculation of process capability

Suggested Readings:

1. Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.
2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. II, 8th Edn. The World Press, Kolkata.
3. Mukhopadhyay, P (2011): Applied Statistics, 2nd edition revised reprint, Books and Allied (P) Ltd.
4. Montogomery, D. C. and Runger, G.C. (2008): Applied Statistics and Probability for Engineers, 3rd Edition reprint, Wiley India Pvt. Ltd.
5. Ehrlich,B.Harris(2002):Transactional Six Sigma and Lean Servicing, 2nd Edition St. Lucie Press.
6. Hoyle, David (1995): ISO Quality Systems Handbook, Heinemann Publication. 2nd Edition, Butterworth.

MJ (E) 3: Econometrics **Credits 04 (FM: 75)**

MJ (E) 3T: Econometrics **Credits 03**

Course Contents:

Unit 1

Introduction: Objective behind building econometric models, nature of econometrics, model building, role of econometrics, structural and reduced forms. Estimation under linear restrictions. Dummy variables, Qualitative data.

Unit 2

Multicollinearity: Introduction and concepts, detection of multicollinearity, consequences, tests and solutions of multicollinearity,

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Unit 3

Autocorrelation: Concept, consequences of auto correlated disturbances, detection and solution of autocorrelation. Generalized least squares estimation (concepts only).

Unit 4

Heteroscedastic disturbances: Concepts and efficiency of Aitken estimator with OLS estimator under heteroscedasticity. Consequences of heteroscedasticity. Tests and solutions of heteroscedasticity. Errors in variables: Correlation between error and regressors.

MJ (E) 3P: Econometrics Lab (Practical) **Credits 01**

List of Practical

1. Problems related to consequences of Multicollinearity.
2. Diagnostics of Multicollinearity.
3. Problems related to consequences of Autocorrelation (AR(I)).
4. Diagnostics of Autocorrelation.
5. Problems related to consequences Heteroscedasticity.
6. Diagnostics of Heteroscedasticity.
7. Estimation of problems of General linear model under Heteroscedastic distance terms.
8. Problems on Autoregressive models.

Suggested Readings:

1. Gujarati, D. and Sangeetha, S. (2007): Basic Econometrics, 4th Edition McGraw Hill Companies
2. Johnston, J. (1972): Econometric Methods, 2nd Edition, McGraw Hill International.
3. Koutsoyiannis, A. (2004): Theory of Econometrics, 2nd Edition, Palgrave Macmillan Limited
4. Maddala, G.S. and Lahiri, K. (2009): Introduction to Econometrics, 4th Edition, John Wiley & Sons.

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MINOR (MI)

MI – 1: Fundamentals of Statistical Methods **Credits 04 (Full Marks: 75)**

MI – 1T: Fundamentals of Statistical Methods **Credits 03**

Course contents:

Unit 1:
Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Frequency distribution, Presentation: tabular and graphic, including histogram and ogives.

Unit 2:
Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis.

Unit 3:
Bivariate data: Definition, scatter diagram, simple correlation coefficient, Statement of rank correlation (Spearman). Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

Unit 4:
Theory of attributes, consistency of data, independence and association of attributes, measures of association and contingency table (Case of 2x2 only).

MI – 1P: Statistical Methods Lab **Credits 01**

List of Practical

13. Graphical representation of data.
14. Problems based on measures of central tendency.
15. Problems based on measures of dispersion.
16. Problems based on combined mean and variance and coefficient of variation.
17. Problems based on moments, skewness and kurtosis.
18. Fitting of polynomials, exponential curves.
19. Karl Pearson correlation coefficient.
20. Multiple correlations
21. Spearman's rank correlation without ties.
22. Correlation coefficient for a bivariate frequency distribution.
23. Lines of regression, angle between lines and estimated values of variables.
24. Checking consistency of data and finding association among attributes.

Suggested Readings:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I& II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. AndBoes, D.C. (2007): Introduction to the theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. Goon A.M., Gupta M.K. and Dasgupta B.: Basic Statistics. The World Press, Kolkata.
5. Chakraborty, Arnab (2016): Probability and Statistics. Sarat Book House.

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MI – 2: Introductory probability **Credits 04 (Full Marks: 75)**

MI – 2T: Introductory probability **Credits 03**

Course contents:

Unit 1:
Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic.

Unit 2:
Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

Unit 3:
Random Variables: Discrete and continuous random variables, p.m.f., p.d.f., c.d.f. Illustrations of random variables and its properties. Expectation, variance, moments and moment generating function.

Unit 4:
Standard probability distributions: Uniform, Binomial, Poisson, Geometric, Rectangular, Normal, Exponential.

MI – 2P: Introductory probability Lab (Practical) **Credits 01**

List of Practical

7. Problems based on area property of normal distribution.
8. To find the ordinate for a given area for normal distribution.
9. Application based problems using normal distribution.
10. Fitting of normal distribution when parameters are given.
11. Fitting of normal distribution when parameters are not given.
12. Problems similar to those in 1 to 5 in case of exponential continuous distributions

Suggested Readings:

7. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
8. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
9. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi
10. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I& II, 8th Edn. The World Press, Kolkata.
11. Chakraborty, Arnab (2016) : Probability and Statistics. Sarat Book House.
12. Ross, S. (2002): A First Course in Probability, Prentice Hall.

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MI3: Basics of Statistical Inference **Credits 04 (FM: 75)**

MI3T: Basics of Statistical Inference **Credits 03**

Course Contents:

Unit 1

Population and Sample, Parameter and Statistic, Population distribution and Sampling distribution.

Statistical Inference: Point Estimation, Interval Estimation and Testing of Statistical Hypothesis. Four useful distributions for statistical Inference; Normal, χ^2, t and F (Statement of the pdf's & shape of the curves). Estimation of population mean, confidence intervals for the parameters of a normal distribution (one sample and two sample problems).

The basic idea of significance test. Null and alternative hypothesis. Type I& Type II errors, level of significance, concept of p-value. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).

Unit 2

Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi-square test.

Unit 3

Tests for the significance of correlation coefficient. Sign test. Wilcoxon two-sample test.

Unit 4

Analysis of variance, one-way and two-way classification. Brief exposure of three basic principles of design of experiments, Statistical concepts of "treatment", "plot" and "block".

Analysis of completely randomized design, randomized complete block design.

MI 3P: Basics of Statistical Inference Lab (Practical) **Credits 01**

List of Practical

15. Estimators of population mean.
16. Confidence interval for the parameters of a normal distribution (one sample and two sample problems).
17. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).
18. Chi-square test of proportions.
19. Chi-square tests of association.
20. Chi-square test of goodness-of-fit.
21. Test for correlation coefficient.
22. Sign test for median.
23. Sign test for symmetry.
24. Wilcoxon two-sample test.
25. Analysis of Variance of a one-way classified data
26. Analysis of Variance of a two-way classified data.
27. Analysis of a CRD.
28. Analysis of an RBD.

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MI4: Applications of Statistics **Credits 04 (FM: 75)**

MI4T: Applications of Statistics **Credits 03**

Course Contents:

Unit 1

Economic Time Series: Components of time series, Decomposition of time series- Additive and multiplicative model with their merits and demerits, Illustrations of time series.

Measurement of trend by method of free-hand curve, method of semi-averages and method of least squares (linear, quadratic and modified exponential). Measurement of seasonal variations by method of ratio to trend.

Unit 2

Index numbers: Definition, Criteria for a good index number, different types of index numbers. Construction of index numbers of prices and quantities, consumer price index number & wholesale price index number. Index of Industrial Production and rate of inflation. Uses and limitations of index numbers.

Measures of Inequality and Development: Gini's coefficient and Lorenz curve, Human Development Index.

Unit 3

Demographic Methods: Introduction, measurement of population, rates and ratios of vital events. Measurement of mortality: CDR, SDR (w.r.t. Age and sex), IMR, Standardized death rates.

Life (mortality) tables: definition of its main functions and uses. Measurement of fertility and reproduction: CBR, GFR, and TFR. Measurement of population growth: GRR, NRR.

MI 4P: Applications of Statistics (Practical) **Credits 01**

List of Practical

9. Measurement of trend: Fitting of linear, quadratic trend, exponential curve and plotting of trend values and comparing with given data graphically.
10. Measurement of seasonal indices by Ratio-to-trend method and plotting of trend values and comparing with given data graphically.
11. Construction of price and quantity index numbers by Laspeyre's formula, Paasche's formula, Marshall-Edgeworth's formula, Fisher's Formula. Comparison and interpretation.
12. Construction of Consumer and wholesale price index numbers, fixed base index number and consumer price index number with interpretation.
13. Gini's coefficient, Lorenz curve, Human Development Index.
14. Computation of measures of mortality.
15. Completion of life table.
16. Computation of measures of fertility and population growth

Suggested Readings:

4. Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency, Calcutta.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II,9th Edition World Press, Kolkata.
6. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, 4th Edition (Reprint), Sultan Chand &Sons

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MI 5: Monte Carlo Method **Credits 04 (FM: 75)**

MI-5T: Monte Carlo Method **Credits 03**

Course Contents:

Unit 1
Using the computer for random number generation (treated as a black box). A brief look at some popular approaches (no mathematical justification needed). Simulating a coin toss, a die roll and a card shuffle.

Unit 2
CDF inversion method. Simulation from standard distributions. Finding probabilities and moments using simulation.

Unit 3
Monte Carlo integration. Basic idea of importance sampling. MCMC not included.

Unit 4
Generating from Binomial and Poisson distributions, and comparing the histograms to the PMFs. Generating from Uniform(0,1) distribution, and applying inverse CDF transforms. Simulating Gaussian distribution using Box-Muller method. Approximating the expectation of a given function of a random variable using simulation. Graphical demonstration of the Law of Large Numbers. Approximating the value of pi by simulating dart throwing.

MI-5P: Monte Carlo Method Lab **Credits 01**

List of Practical

6. Random number generation from Binomial distribution.
7. Random number generation from Poisson distribution.
8. Random number generation from Uniform distribution.
9. Simulation of Gaussian distribution using Box-Muller method.
10. Finding probabilities and moments using simulation from standard distributions.

Suggested Readings:

3. Shonkwiler, Ronald W. and Mendivil, Franklin (2009):Explorations in Monte Carlo Methods (Undergraduate Texts in Mathematics)
4. Carsey, Thomas M. and Harden, Jeffrey J. (2014): Monte Carlo Simulation and Resampling Methods for Social Science.

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MI 6: Project work using R and/ or MS-Excel **Credits 04 (FM: 75)**

MI-5T: Project work using R and/ or MS-Excel **Credits 03**

Course Contents:

Objective: The aim of the course is to initiate students to write and present a statistical report, under the supervision of a faculty, on some area of human interest. The project work will provide hands on training to the students to deal with data emanating from some real-life situation and propel them to dwell on some theory or relate it to some theoretical concepts.

Different statistical concepts using R and/ or MS-Excel to be discussed with the students before the project work:

- Descriptive Statistics: Mean, median, mode, variance, measures of skewness & kurtosis, Correlation coefficient
- Representation of data: By different graphs and tables
- Inferential Statistics: Testing of hypothesis in connection with normal distribution (one sample and two sample problems), Some simple nonparametric tests: Sign test, Wilcoxon two-sample test. Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi-square test.
- Regression Analysis: Handling Simple regression, Multiple regression, Logistic regression
- Analysis of variance: One way and two-way classification

SKILL ENHANCEMENT COURSE (SEC)

TO BE CHOSEN FROM THE BUCKET OF SECs OF SELECTED DISCIPLINE A/B/C
(As per A/B/C Hons. Prog. Syllabus)

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