VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN STATISTICS

4-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 (HONOURS) MAJOR IN STATISTICS
(Under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	1st	I	**SEMESTER-I**							
			Major-1	**STSHMJ101**	**T: Descriptive Statistics-1 & Probability Theory-1; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**STSSEC01**	**P: Statistical Computing using MS Excel**	**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**	ENVS (***common for all programmes***)	**4**	**2-0-2**	**50**	**50**	**100**
			Minor-1 (Disc.-I)	**STSMI01**	**T: Statistical Methods; P: Practical** ***(To be taken by students of other Disciplines)***	**4**	**3-0-1**	**15**	**60**	**75**
					Semester-I Total	**20**				**400**
		II	**SEMESTER-II**							
			Major-2	**STSHMJ102**	**T: Descriptive Statistics-2 & Probability Distributions-1; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**STSSEC02**	**P: Statistical Computing using C/C++ Programming**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC02**	MIL-1 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC02**	Multi Disciplinary Course-02 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			VAC	**VAC02**	Value Added Course-02 (***to be chosen from the list***)	**4**	**4-0-0**	**10**	**40**	**50**
			Minor-2 (Disc.-II)	**STSMI02**	**T: Introductory Probability; P: Practical** ***(To be taken by students of other Disciplines)***	**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**

MJ = Major, MI = Minor Course, 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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MAJOR (MJ)

MJ-1: Descriptive Statistics-1 & Probability Theory-1 Credits 04 (Full Marks: 75)

MJ-1T: Descriptive Statistics-1 & Probability Theory-1 Credits 03

Course contents:

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

Unit 2:
Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: range, mean deviation, standard deviation, coefficient of variation, Gini's Coefficient, Lorenz Curve. Moments, skewness and kurtosis, Quantiles and measures based on them. Stem and Leaf Plot, Box Plot. Outlier Detection. Quantile-Quantile Plot.

Unit 3:
Bivariate data: Definition, scatter diagram, simple correlation, simple linear regression, principle of least squares.

Unit 4:
Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic.
Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

MJ-1P: Descriptive Statistics Lab 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. Karl Pearson correlation coefficient.
7. Correlation coefficient for a bivariate frequency distribution.
8. Lines of regression, angle between lines and estimated values of variables.
9. Stem and Leaf Plot, Box Plot and Q-Q Plot.
10. Application problems based on Classical Definition of Probability
11. Application problems based on Bayes Theorem.

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Suggested Readings:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I, 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. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. Freedman, D., Pisani, R. and Purves, R. (2014): Statistics, 4th Edition, W. W. Norton & Company.
5. Chung, K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer / Narosa.
6. Feller, W. (1968): An Introduction to Probability Theory & its Applications, John Wiley
7. Goon, A.M., Gupta, M.K. & Dasgupta, B. (1994): An Outline of Statistical Theory (Vol-1), World Press
8. Parzen, E. (1972): Modern Probability Theory and its Applications, John Wiley
9. Uspensky, J.V. (1937): Introduction to Mathematical Probability, McGraw Hill
10. Cacoullos, T. (1973): Exercises in Probability. Narosa
11. Rahman, N.A. (1983): Practical Exercises in Probability and Statistics, Griffen
12. Ross, S. (2002): A First Course in Probability, Prentice Hall

MJ-2: Descriptive Statistics-2 & Probability Distributions-1 **Credits 04 (Full Marks: 75)**

MJ-2T: Descriptive Statistics-2 & Probability Distributions-1 **Credits 03**

Course contents:

Unit 1:
Fitting of some non-linear regression equation, correlation ratio, correlation index, Spearman's Rank correlation, Kendall's rank correlation.

Analysis of Categorical Data: Contingency table, measures of association of attributes, relative risk, odds ratio, Pearson's measure, Goodman-Kruskal's measure.

Unit 2:
Random variables: discrete and continuous random variables, p.m.f., p.d.f. and c.d.f., properties of c.d.f, Mathematical expectation and variance.

Unit 3:
Properties of random variables, pgf, mgf and their properties. Some Inequalities: Cauchy-Schwarz inequality, Markov & Chebyshev inequality.
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Unit 4:
Standard discrete distributions: Uniform, Binomial, Poisson, Hypergeometric, Geometric and Negative Binomial. Standard continuous distributions: Rectangular, Normal, Exponential.

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MJ-2P: Descriptive Statistics-2 & Probability Distributions-1 Lab **Credits 01**

List of Practical

1. Spearman's rank correlation.
2. Kendall's rank correlation.
3. Problems on categorical data.
4. Fitting of binomial distributions for given n and p
5. Fitting of binomial distributions after computing mean and variance
6. Fitting of Poisson distributions for given value of lambda
7. Fitting of Poisson distributions after computing mean
8. Fitting of suitable distribution
9. Application problems based on binomial distribution
10. Application problems based on Poisson distribution
11. Fitting of rectangular distribution
12. Fitting of normal distribution
13. Fitting of exponential distribution

Suggested Readings:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I, 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. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. Tukey, J.W.(1977) : Exploratory Data Analysis, Addison-Wesley Publishing Co.
5. Agresti, A. (2010): Analysis of Ordinal Categorical Data, 2nd Edition, Wiley.
6. Freedman, D., Pisani, R. and Purves, R. (2014): Statistics, 4th Edition, W. W. Norton & Company.
7. Chung, K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer / Narosa.
8. Feller, W. (1968): An Introduction to Probability Theory & its Applications, John Wiley
9. Goon, A.M., Gupta, M.K. & Dasgupta, B. (1994): An Outline of Statistical Theory (Vol-1), World Press
10. Parzen, E. (1972): Modern Probability Theory and its Applications, John Wiley
11. Uspensky, J.V. (1937): Introduction to Mathematical Probability, McGraw Hill
12. Cacoullos, T. (1973): Exercises in Probability. Narosa
13. Rahman, N.A. (1983): Practical Exercises in Probability and Statistics, Griffen
14. Ross, S. (2002): A First Course in Probability, Prentice Hall

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MINOR (MI)

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

MI – 1T: 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

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. Spearman's rank correlation without ties.
9. Correlation coefficient for a bivariate frequency distribution.
10. Lines of regression, angle between lines and estimated values of variables.
11. 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.

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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.

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: Statistical Methods Lab — 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.

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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.

SKILL ENHANCEMENT COURSE (SEC)

SEC 1: Statistical Computing using MS Excel Credits 03 (Full Marks: 50)

SEC1P: Statistical Computing using MS Excel

Course Outline:

Unit 1: MS-Excel using toolbar

Concept of spreadsheet, General operation on cells, Data handling and cleaning using filtering, conditional formatting, merge and wrap, sort, text to columns, freeze panes, commenting, data validation, removing duplicates, grouping of data, pivot table and data summarization, importing data into excel, protecting excel worksheet and file.

Unit 2: MS-Excel Functions

Statistical functions, Mathematical functions, logical functions, text functions, lookup and reference functions, date and time functions

Unit 3: Graphs and Charts using MS-Excel

Different types of excel charts such as Line, Bar, Scatter, Pie, Box and Whiskers, Waterfall, Histogram, Area. Some advanced charting techniques using excel. Generation of some special charts using excel: Stem and leaf chart, Lorenz curve, Step diagram, Frequency curve, Population pyramid.

Unit 4: Macro and solver

Concept of Excel macro, creating simple excel macro.
Concept of excel solver, solving some linear and nonlinear equations using excel solver.

Unit 5: Data analysis using MS-Excel

Different descriptive statistics for a dataset: Measures of central tendency, dispersion, skewness and kurtosis, Correlation. Regression analysis. Random number generation from Uniform, Binomial, Poisson, Normal.

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Suggested Readings:

1. Microsoft Excel Bible: The Comprehensive Tutorial Resource, Michael Alexander, Dick Kusleika, Wiley.
2. Excel ALL-IN-ONE for Dummies, Paul McFedries, Greg Harvey, Wiley.
3. Excel: Quickstart Guide from Beginner to Expert, William Fischer.
4. Statistical Analysis with Excel for Dummies, Joseph Schmuller, Wiley.
5. https://www.excel-easy.com/
6. https://www.w3schools.com/excel/index.php

SEC 2: Statistical Computing using C/C++ Programming Credits 03 (Full Marks: 50)

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

Course Outline:

Unit 1: Introduction

Components, basic structure programming, character set, C/C++ tokens, Keywords and Identifiers and execution of a C/C++ program. Data types: Basic data types, Constants and variables: declaration and assignment of variables, Symbolic Constants, overflow and underflow of data.

Operators and Expressions: Arithmetic, relational, logical, assignment, increment/decrement, operators, precedence of operators in arithmetic, relational and logical expression. Implicit and explicit type conversions in expressions, library functions. Managing input and output operations: reading and printing formatted and unformatted data.

Unit 2: Flow control

Decision making and branching - if…else, nesting of if…else, else if ladder, switch, conditional (?) operator. Looping in C/C++: for, nested for, while, do…while, and jumps in and out of loops.
Arrays: Declaration and initialization of one-dim and two-dim arrays.

Unit 3: Functions, Pointer and Files

User- defined functions: A multi-function program using user-defined functions, definition of functions, return values and their types, function prototypes and calls. Category of Functions: no arguments and no return values, arguments but no return values, arguments with return values, no arguments but returns a value, functions that return multiple values.

Pointers: Declaration and initialization of pointer variables, accessing the address of a variable, accessing a variable through its pointer, pointer expressions, pointer increments/decrement and scale factor. Pointers and arrays, arrays of pointers, pointers as function arguments, functions returning pointers.
File inclusion in C/C++: Defining and opening a file (only r, w and a modes), closing a file, I/O operations on files-fscanf and fprintf functions.

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Unit 4: Statistical computing: some suggested programs

- Finding values of a function $y = (x)$ for given values of x.
- Roots of a quadratic equation (with imaginary roots also).
- Sorting of an array
- Preparing grouped and ungrouped frequency table
- Different measures of central tendency for series data and frequency data
- Different measures of dispersion for series data and frequency data
- Different measures of skewness and kurtosis for series data and frequency data
- Computing correlation and fitting of regression lines
- Fitting of exponential curve
- Compute ranks and then calculate rank correlation (without tied ranks)
- Fitting of binomial, poisson distribution
- Random number generation from uniform, binomial, poisson, exponential and normal. Calculate sample mean and variance and compare with population parameters.
- Obtain cdf of binomial and poisson distribution

Suggested Readings:

- Kernighan, B.W. and Ritchie, D. (1988): C Programming Language,2nd Edition, Prentice Hall.
- Balagurusamy, E. (2011): Programming in ANSI C, 6th Edition Tata McGraw Hill.
- Gottfried, B.S. (1998): Schaum's Outlines: Programming with C, 2nd Edition, Tata McGraw Hill.

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