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Re-accredited by NAAC with 'A' Grade with CGPA 3.62/4

Recognised by UGC as "College with Potential for Excellence"

Conferred "College with "STAR STATUS" by DBT, Government of India.

Centre for Research Capacity Building under UGC-STRIDE

ESTD : 1880

St Aloysius College (Autonomous) Mangaluru

Re-accredited by NAAC "A" Grade

Course structure and syllabus of

B.Sc.

STATISTICS

Under NEP Regulations, 2021

ಿತಆಲೋಶಿಯಸ್ ಕಾಲೇಜು (ಸ್ವಾಯತ್ತ)
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Date: 17-08-2022

NOTIFICATION

Sub: Syllabus of **B.Sc. STATISTICS** under NEP Regulations, 2021.
(As per Mangalore University guidelines)

Ref: 1. Decision of the Academic Council meeting held on 18-12-2021 vide Agenda No: 6.22 (2021-22)
2. Decision of the Academic Council meeting held on 09-07-2022 vide Agenda No 14
3. Office Notification dated 21-02-2022
4. Office Notification dated 17-08-2022

Pursuant to the above, the Syllabus of **B.Sc. STATISTICS** under NEP Regulations, 2021 which was approved by the Academic Council at its meeting held on 18-12-2021 & 09-07-2022 is hereby notified for implementation with effect from the academic year **2021-22**.

PRINCIPAL

ST. ALOYSIUS COLLEGE MANGALURU 575 003 (AUTONOMOUS)

REGISTRAR

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office
3. Library

A meeting of the Board of Study in Statistics was held on 19/11/2021

Following members were present for the meeting.

1. Dr. Aruna Kalkur T (Chairperson)
2. Dr. Savitha Kumari (University Nominee), Associate Professor of Statistics, SDM College Ujire.
3. Mr. Umesh Pai (Subject Expert), Associate Professor of Statistics, MGM College, Udupi
4. Dr. Ashwini Kumari (Subject Expert), Asst. Professor of Statistics, Alva's College, Moodbidri
5. Ms. Sonal Caren D'souza, (Member) SAC, Mangaluru
6. Ms. Felicia Roza Martis, (Member) SAC, Mangaluru
7. Ms. Anvitha Jain (Member) SAC, Mangaluru
8. Ms. K Varsha (Student Representative)

Statistics BOS meeting conducted on 27/06/2022

The following members were present for BOS:

1. Dr. Aruna Kalkur T (Chairperson)
2. Dr. Savitha Kumari (University Nominee), Associate Professor of Statistics, SDM College Ujire.
3. Mr. Umesh Pai (Subject Expert), Associate Professor of Statistics, MGM College, Udupi
4. Dr. Ashwini Kumari (Subject Expert), Asst. Professor of Statistics, Alvas College, Moodbidri.
5. Ms. Sonal Caren D'souza, (Member) SAC, Mangaluru
6. Ms. Felicia Roza Martis, (Member) SAC, Mangaluru
7. Ms. Anvitha Jain (Member) SAC, Mangaluru
8. Ms. K Varsha (Student Representative)

Program Outcomes

By the end of the program the students will be able to:

1. Develop and demonstrate an ability to understand major concepts in various disciplines of Statistics.
2. Solve analytical problems independently and draw logical conclusions.
3. Analyse, interpret the data and hence help policy makers to take a proper decision.
4. Have a knowledge regarding use of data analytics tools like Excel, SPSS, R programming and Python.
5. Use modern statistical techniques and statistical Software to understand the concepts of Statistics.
6. Think, acquire knowledge and skills through logical reasoning and inculcate the culture of self-learning.
7. Create an awareness about the impact of Statistics in real life and development outside the scientific community.

Course Structure

Course Code	Title of course	Category of course	Teaching hours per week	SEE	CIE	Total Marks	Credits
SEMESTER I							
G 506 DC1.1	Descriptive Statistics	DSC	04	60	40	100	4
G 506 DC2.1 P	Descriptive Statistics Practical	DSC	04	60	40	100	2
G 506 OE1.1	Statistical Methods	OEC	03	60	40	100	2
SEMESTER II							

G 506 DC1.2	Probability and Distributions	DSC	04	60	40	100	4
G 506 DC2.2 P	Probability and Distributions Practical	DSC	04	60	40	100	2
G 506 OE1.2	Applied Statistics	OEC	03	60	40	100	2

III	**Calculus and Probability Distributions (4) +Practical (2)** Discipline B3(4+2)	OE-3 (3)	L1-3 (3), L2-3(3) (3+1+0 each)		SEC-2: Artificial Intelligence (2) (1+0+2)		23
IV	**Statistical Inference-I (4) + Practical (2)** Discipline B4(4+2)	OE-4 (3)	L1-4 (3), L2-4(3) (3+1+0 each)	Constitution of India(2)		Sports/NCC/NSS etc.(2) (1+0+2)	25
Exit option with Diploma (96 credits)							

Assessment

Weightage for assessments (in percentage)

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	30	70
Practical	15	35 (30+5) (Practical record)
Projects	30	70
Experiential Learning (Internships, etc.)	30	70

Summary of Discipline Specific Courses (DSC)			
Semester	**Course Code**	**Title of the Paper**	**Credits**
I	DSC A1	Descriptive Statistics	4
		Practicals based on DSC A1	2
II	DSC A2	Probability and Distributions	4
		Practicals based on DSC A2	2

Curriculum Structure for the Undergraduate Degree Program B.Sc.

Total Credits for the Program: 176 Starting year of implementation: 2021-22 Name of the Degree Program: B. Sc. Discipline/Subject: Statistics (Major)
Program Articulation Matrix

Sem	Title /Name of the course	Program outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy##	Assessment$
1	**Descriptive Statistics**	PO1, PO2, PO 8	Mathematics of 12th level	1. The course is taught using the traditional chalk and talk method using problem-solving through examples and exercises. 2. Students are encouraged to use resources available on open sources.	The assessment is done using continuous assessment through written tests, open book examinations, viva-voce, seminars, and group discussions.
1	**Practical**	PO5, PO6	Mathematics of 12th level	The course is taught using Excel software and/or manually to carry out descriptive statistical analysis.	Assessment of learning through experiments
2	**Probability and Distributions**	PO7, PO9, PO10	Mathematics of 12th level	1. The course is taught using the traditional chalk and talk method using problem-solving through examples and exercises. 2. Students are encouraged to use resources available on open sources	The assessment is done using continuous assessment through written tests, open book examination, viva-voce, seminars, and group discussions.
2	**Practical**	PO5, PO6	Mathematics of 12th level	The course is taught using R programming software and/or manually to carry out descriptive statistical analysis	Assessment of learning through experiments

Course Outcomes (COs)

At the end of the course the student should be able to:

1. Acquire knowledge of introductory statistics, its scope and importance in various areas such as Medical, Engineering, Agricultural and Social Sciences, etc.
2. Get knowledge of various types of data, their organization and evaluation of summary measures such as measures of central tendency and dispersion, etc.
3. Perceive knowledge of correlation, regression analysis, regression diagnostics, and partial and multiple correlations.
4. Learn different types of data reflecting independence and association between two or more attributes.
5. Develop an ability to critically assess a standard report having graphics and probability statements.
6. Conceptualize the probabilities of events including frequentist and axiomatic approaches. Simultaneously, they will learn the notion of conditional probability including the concept of Bayes' Theorem,
7. Get knowledge related to the concept of discrete and continuous random variables and their probability distributions including expectation and moments,
8. Learn knowledge of important discrete and continuous distributions such as Binomial, Poisson and Normal distributions.
9. Acquire knowledge of R-programming in descriptive statistics and probability models.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1. Knowledge of introductory statistics, its scope and importance in various areas such as Medical, Engineering, Agricultural and Social Sciences, etc.	X	X			X	X						
2. Knowledge of various types of data, their organization and evaluation of summary measures such as measures of central tendency and dispersion, etc.			X	X	X	X				X	X	

3. Knowledge of correlation, regression analysis, regression diagnostics, partial and multiple correlations.				X	X	X		X		X	X	
4. Knowledge of types of data reflecting independence and association between two or more attributes				X	X	X				X		X
5. Develop an ability to critically assess a standard report having graphics and probability statements.					X	X	X		X			
6. Knowledge to conceptualize the probabilities of events including frequentist and axiomatic approaches. Simultaneously, they will learn the notion of conditional probability including the concept of Bayes' Theorem.					X	X			X	X		
7. Knowledge related to the concept of discrete and continuous random variables and their probability distributions including expectations and moments.					X	X			X	X		
8. Knowledge of important discrete and continuous distributions such as Binomial, Poisson and Normal distributions.					X	X			X	X		
9. Knowledge of R-programming in Descriptive Statistics and Probability Models.					X	X			X	X		

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. 'X' in the intersection cell indicates that a particular course outcome addresses that particular program outcome.

B.Sc. Semester 1

Course Title: Descriptive Statistics	
Total Contact Hours: 56	Course Credits:04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Model Syllabus Authors: State-	Summative Assessment Marks: 70

level NEP-model curriculum setting committee members- Statistics	

Title of the Course: Descriptive Statistics **Course Code: G 506 DC1.1**

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
4	56	2	52

Content of Theory Course 1	**56 Hrs**
Unit – 1: Introduction to Statistics	**13 Hrs**
Statistics: Definition and scope. Concepts of statistical population and sample (SRS, Stratified, Systematic and Cluster sampling methods Definitions only). Data: quantitative and qualitative, cross-sectional and time-series, discrete and continuous. Scales of measurement: nominal, ordinal, interval and ratio. Presentation of data: tabular and graphical. Frequency distributions, cumulative frequency distributions and their graphical representations. Stem and leaf displays.	
Unit – 2: Univariate Data Analysis	**18 Hrs**
Measures of Central Tendency: Mean, weighted mean, trimmed mean, Median, Mode, Geometric and harmonic means, properties, merits & limitations and relation between these measures. Measures of Dispersion: Range, Quartile deviation, Mean deviation, Standard deviation and their relative measures. Gini's Coefficient, Lorenz Curve. Moments, Skewness and Kurtosis. Quantiles and measures based on them. Box Plot. Outliers. Chebyshev's inequality, normal data sets.	
Unit – 3: Bivariate Data Analysis	**15 Hrs**
Bivariate Data, Scatter plot, Correlation, Karl Pearson's correlation coefficient, the Rank correlation – Spearman's and Kendall's measures. Concept of errors, Principle of least squares, fitting of polynomial and exponential curves. Simple linear regression and its properties. Fitting of the linear regression line and coefficient of determination.	
Unit –4: Multivariate Data Analysis	**10 Hrs**
Analysis of Categorical Data: Contingency table, independence and association of attributes, measures of association - odds ratio, Pearson's and Yule's measure, Multivariate Frequencies, Multivariate Data Visualization, mean vector and dispersion matrix, Multiple linear regression, multiple and partial correlation coefficients. Residual error variance.	

References

1. Agresti, A. (2010), Analysis of Ordinal Categorical Data, 2nd Edition, Wiley.
2. Anderson T.W. and Jeremy D. Finn (1996), The New Statistical Analysis of Data, Springer.
3. Gupta, S.C. (2018), Fundamental of Statistics, Himalaya Publishing House, 7th Edition.
4. Gupta S.C. and V.K. Kapoor (2020), Fundamental of Mathematical Statistics, Sultan Chand and Co. 12th Edition.
5. Hogg, R. V. McKean J. W. and Craig, A. T. (2012), Introduction to Mathematical Statistics, Pearson 7th Edition.
6. Joao Mendes Moreira, Andre C P L F de Carvalho, Tomas Horvath (2018), General Introduction to Data Analytics, Wiley.
7. Johnson, R.A. and Bhattacharyya, G.K. (2006), Statistics: Principles and methods. 5th Edition, John Wiley & Sons, New York.
8. Medhi, J. (2005), Statistical Methods, New Age International.

Pedagogy

1. The course is taught using the traditional chalk and talk method using problem-solving through examples and exercises.
2. Students are encouraged to use resources available on open sources.

Formative Assessment: Total of 30 marks	
Assessment Occasion/ type	**Weightage in Marks**
Internal Test 1	1/3
Internal Test 2	1/3
Assignment/Seminar (7marks) + Attendance(3marks)	1/3
Total	**01**

Content of Practical Course 1 **G 506 DC1.1P**
(Computing all the practicals manually (2 hrs) and using Excel (2 hrs))

1. Presentation of data by frequency tables, diagrams & graphs, stem & leaf and partition values.
2. Arithmetic Mean (AM), geometric mean, harmonic mean, weighted AM, trimmed mean, corrected mean.
3. Mode, median and partition values.

4. Absolute and relative measures of dispersion, Box plots.
5. Problems on moments, skewness and kurtosis.
6. Fitting of curves by least squares method.
7. Product moment correlation coefficient and rank correlation.
8. Regression of two variables.
9. Multivariate Descriptive statistics, mean Vector, dispersion matrix correlation matrix, Partial and Multiple correlation.
10. Problems on the Association of attributes.

Statistical Methods (Open Elective) G 506 OE1.1

Course Objectives

1. This is an open elective course for other than statistics students.
2. The students will learn the elements of descriptive statistics, probability, and statistical methods such as tests of hypotheses, correlation and regression.

Course Outcomes

Students will be able to

CO1. Acquire knowledge of statistical methods.

CO2. Identify types of data and visualization, analysis and interpretation.

CO3. Know about elementary probability and probability models.

CO4. Employ suitable test procedures for the given data set.

Pedagogy

The course is taught using the traditional chalk and talk method using problem-solving through examples and exercises. Students are encouraged to use resources available on open sources.

Statistical Methods **G 506 OE1.1**	**42 Hrs**
Unit –1: Introduction	**10 Hrs**
Definition and scope of Statistics. Data: quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Presentation: tabular and graphic, including histogram and ogives. Concepts of statistical population and sample. Sampling from finite population - Simple random sampling, Stratified and systematic random sampling procedures (definitions and methods only). Concepts of sampling and non-sampling errors.	
Unit –2: Univariate and Bivariate Data Analysis	**16 Hrs**
Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis. Bivariate data, scatter diagram, Correlation, Karl Pearson's correlation coefficient, Rank correlation. Simple linear regression, the principle of least squares and fitting of polynomials and exponential curves.	

Unit –3: Probability and Distributions	**16 Hrs**
Probability: Random experiment, trial, sample space, events-mutually exclusive and exhaustive events. Classical, statistical and axiomatic definitions of probability, addition and multiplication theorems. Discrete and continuous random variables, probability mass and density functions, distribution functions, and expectation of a random variable. Standard univariate distributions: Binomial, Poisson and Normal distributions (Elementary properties and applications only).	

References

1. Daniel, W. W. (2007), Biostatistics - A Foundation for Analysis in the Health Sciences, Wiley.
2. Anderson T.W. and Jeremy D. Finn (1996), The New Statistical Analysis of Data, Springer.
3. Mukhyopadyaya P (1999), Applied Statistics, New Central Book Agency, Calcutta.
4. Ross, S.M. (2014), Introduction to Probability and Statistics for Engineers and Scientists.
5. Cochran, W G (1984), Sampling Techniques, Wiley Eastern, New Delhi.

B.Sc. Semester 2

Course Title: Probability and Distributions	
Total Contact Hours: 56	Total Contact Hours: 56
Formative Assessment Marks: 30	Formative Assessment Marks: 30
Model Syllabus Authors: State-level NEP-model curriculum setting committee members-Statistics	Model Syllabus Authors: State-level NEP-model curriculum setting committee members-Statistics

Course Pre-requisite(s): II PUC with Mathematics

Title of the Course: Probability and Distributions G506 DC1.2

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
4	56	2	52

Content of Theory Course 2	56 Hrs
Unit –1: Probability	**15 Hrs**
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.	
Unit –2: Random Variables and Mathematical Expectation	**12 Hrs**
Definitions of discrete and continuous random variables, Distribution function, probability mass and density functions – properties and illustrations, Expectation of a random variable and rules of expectation and related results, Moments and moment generating function – properties and uses.	
Unit –3: Standard Distributions	**15 Hrs**
Bernoulli, Binomial, Poisson - mean, variance, moments and m. g. f. recursive relations for probabilities. Discrete Uniform, Negative Binomial, Geometric, Hyper-Geometric distributions – mean and variance. Applications of all these distributions.	
Unit –4: Data Analysis Using R	**14 Hrs**
Introduction to R: Installation, command line environment, an overview of capabilities, brief mention of open-source philosophy. R as a calculator: The four basic arithmetic operations. Use of parentheses nesting up to arbitrary level. The power operation. Evaluation of simple expressions. Quotient and remainder operations for integers. Standard functions, e.g., sin, cos, exp, log. The different types of numbers in R: Division by zero leading to Inf or -Inf. NaN. NA. No need to go into details. Variables. Creating a vector using c (), seq() and colon operator. How functions map over vectors. Functions to summarize a vector: sum, mean, sd, median, etc. Extracting a subset from the vector (by index, by the property). R as a graphing calculator:	

Introduction to plotting. Plot (), lines (), abline(). No details about the graphics parameters except colour and line width. Barplot, Pie chart and Histogram. Box plot. Scatter plot and simple linear regression using lm(y~x). Problems on discrete and continuous probability distributions.	

References

1. Ross, S.M. (2014), Introduction to Probability and Statistics for Engineers and Scientists, 5th Edition, Academic Press.
2. Ross, S. (2002), A First Course in Probability, Prentice Hall.
3. Tukey, J.W. (1977), Exploratory Data Analysis, Addison-Wesley Publishing Co.
4. Dudewitz. E.J. and Mishra. S. N. (1998), Modern Mathematical Statistics, John Wiley.
5. Goon A.M., Gupta M.K., Das Gupta. B. (1991), Fundamentals of Statistics, Vol. I, World Press, Calcutta.
6. Gupta. S.C and V.K. Kapoor (2020), Fundamentals of Mathematical Statistics, Sultan Chand and Co, 12th Edition.
7. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009), Probability and Statistical Inference, Seventh Edition, Pearson Education, New Delhi.
8. Mood, A.M., Graybill, F.A. and Boes, D.C. (2007), Introduction to the Theory of Statistics, 3rd Edition. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
9. Sudha G. Purohit, Sharad D. Gore, Shailaja R Deshmukh (2009), Statistics Using R, Narosa Publishing House.
10. R for beginners by Emmanuel Paradis (freely available at **https://cran.r project.org/doc/contrib/Paradisrdebuts_en.pd**

Pedagogy

1. The course is taught using the traditional chalk and talk method using problem-solving through examples and exercises.
2. Students are encouraged to use resources available on open sources.

Formative Assessment: 30 marks	
Assessment Occasion/ type	**Weightage in Marks**
Internal Test 1	1/3
Internal Test 2	1/3
Assignment/Seminar(7marks) +Attendance(3marks)	1/3
Total	**01**

Content of Practical Course 2:
List of Experiments to be conducted (Computing all the practicals manually and using Excel/R)

1. Computing probability: using addition and multiplication theorems.
2. Conditional probability and Bayes' theorem.
3. Two exercises on Descriptive statistics (Presentations, Summarizations, correlations, regression and Graphs using R)
4. Problems on pmf, expectation, variance, quantiles, skewness, kurtosis (Discrete Case).
5. Problems on pdf, expectation, variance, quantiles, skewness, kurtosis (Continuous case).
6. Problems on discrete probability distributions (Binomial, Poisson, Negative – Binomial, Geometric, and discrete uniform.
7. Computation of moments and Moment generating functions (Discrete and Continuous Case).
8. Fitting of distributions Binomial and Poisson distributions.
9. Generation of random samples. (Binomial, Poisson, Geometric Distributions)

Applied Statistics (Open Elective) G 506 OE1.2

Course Objectives

1. To enable the students to use statistical tools in finance, industries, population studies and health sciences.
2. To acquire knowledge about sampling methods for surveys.

Course Outcomes (CO)

Upon successful completion of this course, the student will be able to:

CO1. Understand the Price and Quantity Index numbers and their different measures and understand the applicability of the cost-of-living Index number.

CO2. Know the components & need for Time series and understand the different methods of studying trends and Seasonal Index.

CO3. Study the concept of vital statistics, sources of data and different measures of Fertility and Mortality and understand the Growth rates- GRR and NRR and interpretations.

CO4. Know the concept of Population, Sample, Sampling unit, sampling design, sampling frame, sampling scheme, need for sampling, apply the different sampling methods for designing and selecting a sample from a population, explain sampling and non-sampling errors.

CO5. Describe the philosophy of statistical quality control tools as well as their usefulness In industry and hence develop quality control tools in a given situation.

Pedagogy

The course is taught using the traditional chalk and talk method using problem-solving through examples and exercises. Students are encouraged to use resources available on open sources.

Contents

Applied Statistics G 506 OE1.2	**42Hrs**
Unit –1: Index numbers	**16 Hrs**
Definition, Criteria for a good index number and different types of index numbers. Construction of index numbers of prices and quantities, consumer price index number. Uses and limitations of index numbers. Consumer price index number: Construction of consumer price index numbers. Applications	

of consumer price index numbers.	
Unit-2: Time Series Analysis	**16 Hrs**
Components of time series, Decomposition of time series- Additive and multiplicative model with their merits and demerits, Illustrations of time series. Measurement of the trend by method of the free-hand curve, method of semi-averages and method of least squares (linear). Measurement of seasonal variations by the method of ratio to trend.	
Unit –3: Vital Statistics	**16 Hrs**
Sources of demographic data, errors in data. **Measurement of mortality:** crude death rate, specific death rates and standardized death rates, infant mortality rate, maternal mortality rate, neonatal mortality rates, merits and demerits and comparisons of various mortality rates. **Measurement of Fertility and Reproduction:** Fecundity, fertility, measurement of fertility, crude birth rate, general fertility rate, age-specific fertility rate and total fertility rates, merits and demerits of each measure of fertility, comparative study of these measures of fertility, Growth rates: Gross reproduction rate and Net reproduction rates.	

References

1. J. Medhi (1992), Statistical Methods, New Age International (P) Ltd. New Delhi.
2. 2. M.N. Das (1993), Statistical Methods and Concepts, Wiley Eastern Ltd.
3. Irwin Miller, John E Freund and Richard A Johnson (1992), Probability and Statistics for Engineers, Prentice Hall of India New Delhi.
4. Mukhopadhaya P (1998), Theory and Methods of Survey Sampling, Prentice Hall of India.
5. Mukhopadhyay P. (2011), Applied Statistics, 2nd ed. Revised reprint, Books and Allied.
6. Kendall M.G. (1976), Time Series, Charles Griffin.
7. Chatfield C. (1980), The Analysis of Time Series –An Introduction, Chapman & Hall.