

GOVERNMENT COLLEGE, SANQUELIM-GOA

POST GRADUATE DIPLOMA IN APPLIED STATISTICS

1. INTRODUCTION

The Post Graduate Diploma in Applied Statistics is an initiative of the **Directorate of Higher Education**, Government of Goa. It is coordinated by the Post Graduate Department and Research Centre in Economics of Government College, Sanquelim-Goa and is duly approved by the **Government of Goa and affiliated to the Goa University**. The programme is framed considering the needs of the working professionals serving in Government and Non-Government Organisations as well as the ones who wish to improve their skills to take up research and field related jobs. The programme will provide the required knowledge and hands-on training in selected areas of Statistics and equip the learners with the skills of using appropriate software for statistical applications in various fields.

Presently, the programme is based on the OA-28 relating to Common Ordinance governing (a) the Post Graduate Diploma Programme in specialized fields/ areas/ subjects offered at the Post-Graduate teaching Departments and at affiliated colleges/recognized institutions of Goa University (*Effective from 16th May, 2019*) which may be revised as per the Goa University guidelines. The third batch of the programme will commence from 08th July 2023.

1.1 The Objectives of the Programme

1. To provide opportunities for continuing education and skill formation for human resource development required in different sectors of employment.
2. To acquaint the learners with the application of statistical tools in the analysis of data.
3. To provide the knowledge and hands-on training in selected areas of statistics
4. To equip learners with the skills of using appropriate software for statistical applications in various fields.
5. To help the learners in career progression.

1.2 Programme Outcomes

On successful completion of the Programme, the candidate will be able to:

- Apply various types of sampling methods to data collection.
- Create and interpret frequency tables.
- Display data graphically and interpret graphs.
- Recognize, describe, and calculate the measures suitable to the data sets.
- Use basic statistical tools to apply for a given research problem.
- Process and manage voluminous data using Statistical software.
- Make predictions and decisions based on data analysis.

2. PROGRAMME STRUCTURE AND DETAILS

2.1 The programme will consist of 32 credits comprising of 7 core courses of 4 credits each (five theory courses and two Practical courses) and two elective courses 2 credits each.

Core Courses (Theory): 20 credits

Core Course (Practical): 8 credits

Optional Courses (Theory): 4 credits

2.2 Course Details

Effective from Academic Year: 2021-22

Sr. No.	Code	Course Title	Credits	Total Contact Hours
Semester I				
		Core Courses		
1.	DASC 01	Basic Mathematics	4	48
2.	DASC 02	Descriptive Statistics	4	48
3.	DASC 03	Probability Theory	4	48
4.	DASC 04	Practical I: Basic Statistics	4	48
Semester II				
		Core Courses		
5.	DASC 05	Statistical Inference	4	48
6.	DASC 06	Statistical Techniques	4	48
7.	DASC 07+	Practical II	4	48
		Elective Courses (Four Credits)		
8.	DASE 08(1)	Time Series Analysis	2	24
9.	DASE 08(2)	Demography	2	24
10.	DASE 08(3)	Econometrics	2	24
11.	DASE 08(4)	Any other Course of relevance	4	48

3. DURATION OF THE PROGRAMME

The duration of the PG Diploma Programme is Two semesters conducted during weekends (Saturdays and Sundays).

4. ELIGIBILITY FOR ADMISSION

Essential: The candidate must have passed the Bachelor's Degree examination of Goa University or an equivalent examination of any other recognized University.

Desirable: The candidate is an employee of Government or a Non-Government Organisation.

5. FEES

The total Annual Fees of the programme is Rs. 20000/- including University registration fees, University Examination fees for Goa University students and Rs. 23200/- for other University students.

6. ADMISSION PROCESS

The interested candidates are required to submit the Google form with the link <https://forms.gle/spyowoV6CxXrmjqz9> by 17th June 2023. Admission will be based on first come first served cum merit basis.

7. SYLLABI

SEMESTER I

CORE COURSES

COURSE CODE: DASC: 01 TITLE OF THE COURSE: BASIC MATHEMATICS

NUMBER OF CREDITS: 4

TOTAL CONTACT HOURS: 48

Objective	To introduce elementary mathematical concepts and tools which are useful in understanding the numerical and derivations in the remaining courses of the programme.	Contact Hours
Outcomes	On successful completion of the Course, the candidate will be able to have basic idea related to the use of real numbers, Sets, functions and limits, matrices, differentiation and integration which are useful for the programme.	
Content	<p>1. Set theory</p> <p>Types of sets, Operation on sets, Distributive properties and Demorgans laws, Venn diagrams, Number of elements in a set, Applications of sets.</p> <p>2. Matrices and Determinants</p> <p>Types of matrices, Elementary operations on matrices, Determinant of a matrix, Cramer's rule, Solution of linear equations using matrices and determinants, Consistency of linear equations. (No theorems and proofs).</p> <p>3. Functions and Limits</p> <p>Cartesian coordinate system, ordered pairs, Cartesian product, Relations, Functions, Types of functions, Limit of a function, Concept of continuity.</p> <p>4. Differentiation</p> <p>Definition of derivative of a function, Standard forms for differentiation, Derivatives of functions (algebraic, exponential and logarithmic only). Rules for differentiation, Applications of differentiation in commerce and economics, Concept of partial derivatives.</p> <p>5. Integration</p> <p>Meaning of integration, Standard forms, Methods of finding integrals of algebraic, exponential and logarithmic expressions, Definite integration, Application of integration in science, commerce and economics, Area under a curve (No theorems and proofs).</p>	<p>10</p> <p>10</p> <p>10</p> <p>9</p> <p>9</p>
Pedagogy	<ul style="list-style-type: none"> • Traditional Chalk board Classes. • Online / Power-point presentations & Videos • Assignments and presentations. 	
References / Readings	<ul style="list-style-type: none"> • Shanti Narayan (2009) A Textbook of Matrices, S. Chand & Co, New Delhi • Mittal P. K, Mathematics for Degree Students (2010), S. Chand & Co. Mumbai • Chitale S.G & Joshi N, A New Approach to mathematical Techniques, Sheth Publishers, Mumbai. • Shanti Narayan, Differential Calculus, S. Chand & Co. New Delhi. 	

COURSE CODE: DASC: 02 TITLE OF THE COURSE: DESCRIPTIVE STATISTICS

NUMBER OF CREDITS: 4

TOTAL CONTACT HOURS: 48

Objective	<p>The learner should be able to understand:</p> <ul style="list-style-type: none"> • the properties of a distribution and to analyse and compare two or more distributions. • the statistical relationship and quantitative measures of relationship between two variables for determining the strength of relationship. • the average relationship between two variables in terms of regression analysis and the multiple and partial correlation. • the characteristics and analysis of qualitative data. 	Contact Hours
Outcomes	<ul style="list-style-type: none"> • On successful completion of the Course, the candidate will be able to apply quantitative and qualitative techniques of statistics in the analysis of data. 	
Content	<p>1. Analysis of Quantitative Data Types of data; Collection and summarization of univariate and bivariate data including graphical methods; Measures of Central Tendency; Measures of Dispersion; Moments; Skewness and Kurtosis; Bivariate and multivariate normal distributions.</p> <p>2. Bivariate continuous distributions, conditional and marginal distributions. Fitting of Curves; Correlation Coefficient; Rank Correlation; Intra-Class Correlation; Discriminant and Cluster analysis; Principal component analysis.</p> <p>3. Regression and Multiple Correlations Linear Regression; Plane of Regression; Multiple Correlation; Partial Correlation.</p> <p>4. Theory of Attributes Classification of Attributes; Independence of Attributes; Association of Attributes; Association of Attributes for $r \times s$ Contingency Table.</p>	<p>14</p> <p>14</p> <p>10</p> <p>10</p>
Pedagogy	<ul style="list-style-type: none"> • Traditional Chalk board Classes. • Online / Power-point presentations & Videos • Lab exercises • Assignments and presentations. 	
References / Readings	<ul style="list-style-type: none"> • Goon A.M., Gupta M.K. and Dasgupta B. (2002), Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata. • Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia. • 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. • D. Freedman, R. Pisani and R. Purves, Statistics, Norton & Company. 	

COURSE CODE: DASC: 03 TITLE OF THE COURSE: PROBABILITY THEORY

NUMBER OF CREDITS: 4

TOTAL CONTACT HOURS: 48

Objective	To introduce the concepts, approaches and laws of probability and to familiarise with the useful aspects of random experiments and computation of probabilities; probability and distribution functions for univariate and bivariate random variables for discrete and continuous cases; mathematical expectation, standard continuous distributions.	Contact Hours
Outcomes	On successful completion of the Course, the candidate will understand to make predictions based on data analysis.	
Content	<p>1. Basic Concepts in Probability Introduction to Probability; Different Approaches to Probability Theory; Laws of Probability; Bayes Theorem.</p> <p>Module 2: Random Variables and Expectation Random Variables; Bivariate Discrete Random Variables; Bivariate Continuous Random Variables; Mathematical Expectation.</p> <p>Module 3: Discrete Probability Distributions Binomial Distribution; Poisson Distribution; Discrete Uniform and Hypergeometric Distributions; Geometric and Negative Binomial Distributions.</p> <p>Module 4: Continuous Probability Distributions Normal Distribution; Area Property of Normal Distribution; Continuous Uniform and Exponential Distributions; Gamma and Beta Distributions.</p>	<p>14</p> <p>12</p> <p>12</p> <p>10</p>
Pedagogy	<ul style="list-style-type: none"> • Traditional Chalk board Classes. • Online / Power-point presentations & Videos • Lab exercises • Assignments and presentations. 	
References / Readings	<ul style="list-style-type: none"> • Goon A.M., Gupta M.K. and Dasgupta B. (2002), Fundamentals of Statistics, Vol. I, 8th Edn. The World Press, Kolkata. • Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi. • Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia. • Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi. 	

COURSE CODE: DASC:04 TITLE OF THE COURSE: PRACTICAL I- BASIC STATISTICS

NUMBER OF CREDITS: 4

TOTAL CONTACT HOURS: 48

Objective	To acquaint with the use of MS Excel for graphical representation of data and use of various statistical techniques for processing of data.	Contact Hours
Outcomes	On successful completion of the Course, the candidate will be able to use MS Excel to display data graphically and use the statistical tools suitable to the data sets.	
Content	Introduction to MS Excel; Classification and Tabulation of Data; Diagrammatic Presentation of Data. Graphical Presentation of Data; Graphical Presentation of Time Series Data; Measures of Central Tendency; Measures of Dispersion Moments, Skewness and Kurtosis; Correlation Analysis; One Sample Tests; Two Sample Tests; Analysis of Variance; Design of Experiments. Finding probabilities: Binomial & Poisson.	2hr. x 24
Pedagogy	<ul style="list-style-type: none">• Lab demonstration and exercises using MS Excel• Online / Power-point presentations & Videos• Assignments and presentations	

SEMESTER II

CORE COURSES

COURSE CODE: DASC: 05 TITLE OF THE COURSE: STATISTICAL INFERENCE

NUMBER OF CREDITS: 4

TOTAL CONTACT HOURS: 48

Objective	Learning basic concepts and methodologies of sampling distributions with their applications, estimation theory, parametric and non-parametric testing of hypothesis and to draw inferences about the population on the basis of samples by using appropriate statistical techniques.	Contact Hours
Outcomes	Successful completion of the Course will enable the learner to apply appropriate statistical techniques to draw inferences about the population on the basis of samples.	
Content	1. Sampling Distributions Introduction to Sampling Distribution; Sampling Distributions of Statistics; Standard Sampling Distributions-I; Standard Sampling Distributions-II.	12
	2. Estimation Introduction to Estimation; Point Estimation; Interval Estimation for One Population; Interval Estimation for Two Populations.	12
	3. Testing of Hypothesis Concepts of Testing of Hypothesis; Large Sample Tests; Small Sample Tests; Chi-Square and F-Tests	12
	Module IV: Non-parametric Tests One-Sample Tests; Two-Sample Tests; k-Sample Tests; Analysis of Frequencies.	12
Pedagogy	<ul style="list-style-type: none"> • Traditional Chalk board Classes. • Online / Power-point presentations & Videos • Lab exercises • Assignments and presentations. 	
References / Readings	<ul style="list-style-type: none"> • Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997) Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd. • Dudewicz, E. J., and Mishra, S. N. (1988): Modern Mathematical Statistics. John Wiley & Sons. • Goon A.M., Gupta M.K.: Das Gupta B. (2005), Fundamentals of Statistics, Vol. I, World Press, Calcutta. • Miller, I. and Miller, M. (2002), E. Freund's Mathematical Statistics (6th addition, low price edition), Prentice Hall of India. • Mood A.M, Graybill F.A. and Boes D.C, Introduction to the Theory of Statistics, McGraw Hill. • Rohatgi V. K. and Saleh, A.K. Md. E. (2009), An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons. 	

COURSE CODE: DASC: 06 TITLE OF THE COURSE: STATISTICAL TECHNIQUES

NUMBER OF CREDITS: 4

TOTAL CONTACT HOURS: 48

Objective	To acquaint the learners with the statistical techniques useful for Sample surveys and their analysis, ANOVA, design of experiments and some useful methods of generation of random numbers and applications of simulation techniques.	Contact Hours
Outcomes	Successful completion of the Course will help the learner to prepare appropriate sampling design and use suitable statistical techniques for sample data.	
Content	<p>1. Sampling Designs Introduction to Sample Surveys; Simple Random Sampling; Stratified Random Sampling; Some Other Sampling Schemes.</p> <p>2. Analysis of Variance Introduction to Analysis of Variance; One-way Analysis of Variance; Two-way Analysis of Variance; Two-way Analysis of Variance with m Observations per Cell.</p> <p>3. Design of Experiments Completely Randomised Design; Randomised Block Design; Latin Square Design; Factorial Experiments.</p> <p>Module IV: Random Numbers Generation and Simulation Techniques Random Number Generation for Discrete Variables; Random Number Generation for Continuous Variables; Simulation Techniques; Applications of Simulation.</p>	<p>12</p> <p>12</p> <p>12</p> <p>12</p>
Pedagogy	<ul style="list-style-type: none"> • Traditional Chalk board Classes. • Online / Power-point presentations & Videos • Lab exercises • Assignments and presentations. 	
References / Readings	<ul style="list-style-type: none"> • Gentle J.E. (1998), Random Number Generation and Monte Carlo Methods, Spriner-Verlag, New York. • Robert C.P. and Casella G. (1999), Monte Carlo Statistical Methods, Springer-Verlag, New York. • Good P.I. (1999), Resampling Methods: A Practical Guide to Data Analysis, Birkhauser, Boston. • Davison and Hinkley (1997), Bootstrap Methods and their Application, Camb. Univ. Press, Cambridge. • P McCullagh and J.A. Nelder (1989), Generalized Linear Models, 2nd Ed, Chapman and Hall. • Wu, C. F. J. And Hamada, M. (2009), Experiments, Analysis, and Parameter Design Optimization (Second edition), John Wiley. • Renchner, A. C. And Schaalje, G. B. (2008). Linear Models in Statistics (Second edition), John Wiley and Sons. 	

COURSE CODE: DASC: 07

**TITLE OF THE COURSE: PRACTICAL II
USING LATEST STATISTICAL SOFTWARE**

NUMBER OF CREDITS: 4

TOTAL CONTACT HOURS: 48

Objective	To introduce and acquaint the learner with the use of latest statistical software for processing and managing voluminous data.	Contact Hours
Outcomes	On successful completion of the Course, the candidate will process and manage voluminous data by using the latest statistical software.	
Content	Introduction to the latest software like R, SAS, and SPSS with hands-on training on computers. Control Charts for Mean; Control Charts for Mean using Range; Control Charts for Mean using Standard Deviation; Control Charts for Range; Control Charts for Standard Deviation; Simple Linear Regression; Multiple Linear Regression; Regression with Dummy Variable; Variable Selection Methods; Estimation of Trend by Curve Fitting; Smoothing or Filtering the Time Series; Seasonal Component Analysis. Distribution of Quadratic forms; Simple Linear Regression; Multiple Regression; Tests for Hypothesis; Analysis of Variance of a one way classified data; Analysis of Variance of a two way classified data with one observation per cell; Analysis of Covariance of a one way classified data; Analysis of Covariance of a two way classified data.	2Hr. * 24
Pedagogy	<ul style="list-style-type: none">• Lab demonstration and exercises using MS Excel• Online / Power-point presentations & Videos• Assignments and presentations.	

ELECTIVE COURSES

COURSE CODE: DASE 08 (1) TITLE OF THE COURSE: DEMOGRAPHY

NUMBER OF CREDITS: 2

TOTAL CONTACT HOURS: 24

Objective	To provide knowledge of different concepts of demography, sources of data, evaluation and adjustment of data.	Contact Hours
Outcomes	The learner will be acquainted with the knowledge of different concepts of demography, sources of data and describe demographic measurements, evaluate and adjust data.	
Content	<ol style="list-style-type: none"> 1. Scope and importance of demography 2. Data sources and their limitations: Population census, Vital registration, Population register, Demographic and Health surveys, other sources. 3. Evaluation and adjustment of census and survey data on age-sex distribution. Growth of Human Population: Rate of natural increase; Arithmetic, Geometric and Exponential growths. 4. International statistical classification of diseases, injuries and causes of death. Measures based on diseases (i.e., morbidity), death (i.e., mortality) and birth (i.e., fertility) statistics including measures such as Gross and Net reproduction rates, Mean length of generation, and Census measures of fertility. 5. Life Tables: Definition, simple construction and applications. Concept of Migration. 	3 6 6 6 3
Pedagogy	<ul style="list-style-type: none"> • Traditional Chalk board Classes. • Online / Power-point presentations & Videos • Assignments and presentations 	
References / Readings	<ul style="list-style-type: none"> • H.S. Shryock and J. S. Siegel (1976) The Methods and Materials of Demography (Studies in Population). • K. Srinivasan (1998) Basic Demographic Techniques and Applications, Sage. • R. Ramkumar (2018), Technical Demography, New Age International, Second edition. 	

COURSE CODE: DASE 08 (2) TITLE OF THE COURSE: TIME SERIES ANALYSIS

NUMBER OF CREDITS: 2

TOTAL CONTACT HOURS: 24

Objective	<ul style="list-style-type: none"> To introduce learner to time series methods and the applications of these methods to different types of data. 	Contact Hours
Outcomes	<p>Upon successful completion, students will have the knowledge and skills to:</p> <ul style="list-style-type: none"> Apply the concept of stationarity to the analysis of time series data Run and interpret time-series models and regression models for time series; Use the Box-Jenkins approach to model and forecast time-series data empirically; Use appropriate models to analyse time series data; Utilise fundamental research skills in applied time series analysis; Use software packages for analysing time series data. 	
Content	<p>1. Exploratory Analysis of Time Series: Graphical display; classical decomposition model – trend, seasonal and cyclical components. 6</p> <p>2. Stationary Stochastic Time Series: Weak and strong stationarity; Auto Regressive (AR), Moving Average (MA) and Auto Regressive Moving Average, (ARMA) models; Box-Jenkin’s correlogram analysis – Auto Correlation Function (ACF) and Partial Correlation Function (PACF); diagnostic tests. 8</p> <p>3. Non-Stationary Time Series: Auto-Regressive Integrated Moving Average (ARIMA) model; deterministic and stochastic trends; unit root tests – DF and ADF tests. 6</p> <p>4. Forecasting based on ARIMA/ARMA model; Introductory Vector Autoregression (VAR) Analysis. 4</p>	
Pedagogy	<ul style="list-style-type: none"> Traditional Chalk board Classes. Online / Power-point presentations & Videos Lab exercises Assignments and presentations. 	
References / Readings	<ul style="list-style-type: none"> Brockwell, P. and R.A. Davis (2002): Introduction to Time Series and Forecasting, 2nd edition, Springer- Verlag. Chatfield, C. (1996): Analysis of Time Series, 5th edition, Chapman & Hall. Mills, T.C. (1990): Time Series Techniques for Economists, Cambridge University Press. Mills, T.C. (1999): The Econometric Modelling of Financial Time Series, 2nd edition, Cambridge University Press. 	

COURSE CODE: DASE 08 (3)

TITLE OF THE COURSE: ECONOMETRICS

NUMBER OF CREDITS: 2

TOTAL CONTACT HOURS: 24

Objective	To provide learners with the knowledge and skills of basic applied econometrics to enable them to understand and to conduct basic econometrics analyses.	Contact Hours
Outcomes	Upon successful completion, learners will be able to understand, evaluate and analyse economic data; interpret statistical evidence from economic data.	
Content	1. Classical Linear Regression Model: Assumptions; OLS method of estimation; tests of hypotheses; use of dummy variables in regression. 2. Problems of Heteroscedasticity and Autocorrelation: GLS method of estimation; tests for heteroscedasticity and autocorrelation. 3. Multicollinearity: Nature of the problem and its consequences; econometric solutions. 4. Introductory Analysis of Panel Data.	8 8 4 4
Pedagogy	<ul style="list-style-type: none">• Traditional Chalk board Classes.• Online / Power-point presentations & Videos• Lab exercises• Assignments and presentations.	
References / Readings	<ul style="list-style-type: none">• Brooks Chris (2002), Introductory Econometrics for Finance, Cambridge University Press.• Johnston, J. and J. DiNardo (1997), Econometrics Methods, 4th edition, McGraw-Hill.• Kmenta, J. (1990), Elements of Econometrics, 2nd edition, Macmillan.• Maddala, G.S. (2001), Introduction to Econometrics, John Wiley.	

8. EVALUATION OF THE PROGRAMME

The assessment of all Courses shall comprise continuous intra-Semester Assessment (ISA) and Semester-End Assessment (SEA). The weightage for the continuous ISA and SEA in both Theory and Practical Courses shall be 40% and 60% respectively.

There shall be two ISAs for each Course of two or more Credits, each of 20%, for a total of 40% of total marks of the Course. An additional assessment may be provided on the request of students to improve the Grade, in which case the best two assessments shall be considered. All internal assessments shall be completed by the last teaching day of the Semester.

SEA shall be conducted at the end of each semester. The examination shall consist of either a comprehensive written test or a comprehensive laboratory examination, depending on whether it is a theory Course or laboratory / practical Course.

The written examination and the practical examination carrying 04 Credits shall be of three hours duration and 02 Credits will be of two hours duration.

Each Course shall have a "Single passing-head" based on the combined performance at the continuous ISA and SEA. Fractional marks shall be rounded off to the nearest integer only at the time of calculating the Course grade.

The marks awarded in the ISA and SEA shall be added for awarding the grade for each Course, as indicated in the table below:

Range of percentage scored	Grades	Grade Points
85 – 100	O (Outstanding)	10
75 – <85	A+ (Excellent)	9
65 – <75	A (Very Good)	8
55 – <65	B+ (Good)	7
50 – <55	B (Above Average)	6
45 – <50	C (Average)	5
40 – <45	P (Pass)	4
0 – <40	F (Fail) , Ab (Absent)	0

Every student shall have to secure a minimum of “P” grade (40%) to pass the Course. Students who do not secure a minimum of “P” Grade in a Course shall have the option of answering SEA in the following Semester(s), or to repeat the Course by registering for the Course whenever it is offered in the regular programme.

9. CONTACT PERSON

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