AC – 07/07/2023
Item No. –6.37 (N)

As Per NEP 2020

University of Mumbai

Title of the program

A- P.G. Diploma in Applied Statistics with Software (PGDASS)

Syllabus for

Semester – I & II

Ref: GR dated 16th May, 2023 for Credit Structure of PG

(With effect from the academic year 2023-24)

Preamble

1) **Introduction:**
PGDASS is a one year (two semesters) program. The program consists of 44 credits. For each semester there are 22 credits. In semester I, "Research methodology" of four credits is a compulsory course along with this there are three mandatory courses each of four credits and one practical course of two credits. One elective course of four credits can be selected out of two elective courses. In semester II, there are two mandatory courses each of four credits, two mandatory courses each of two credits and one practical course of two credits. One elective course of four credits can be selected out of two elective courses. In addition to this, students have to complete one statistical project of four credits.

2) **Aims and Objectives:**
Aim of the program is to introduce Statistics and its applications to learners who haven't studied Statistics at major level. The program accentuates both the fundamentals and modern applications of statistics. The program is structured so that students will have enough knowledge of Applied Statistics and necessary skills in Statistics for the employability in corporate. The program has the unique features like, research methodology, project, software use and adequate amount of courses in core as well as in applied Statistics.

3) **Learning Outcomes:**
On completion of this program learners will have,

a) Knowledge of ethical values to become a responsible Statistician.

b) Fair knowledge of fundamentals in statistics such as probability, statistical modeling, multivariate techniques etc.

c) Fluency in statistical computing using SPSS, MINITAB, R- language, Python etc.

d) Knowledge of reframing real situation information into statistical language, analyzing the data and to draw valid inferences based on it.

4) **Any other point (if any)**

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5) **Baskets of Electives:**
For semester I:

- Statistics in Market research,
- Categorical data analysis

For semester II:

- Six sigma and total quality management,
- Elements of data science

Credit Structure of the Program (Table as per (Parishishth 1) with sign of HOD and Dean): Structure attached

Year (1 Yr PG)	Level	Sem. (1 Yr)	Major		RM	OJT / FP	RP	Cum. Cr.	Degree
			Mandatory*	Electives Any one					
I	6.0	Sem I	502: Basic Statistics (04) 503: Applied regression analysis and Analysis of variance (04) 504: Applied multivariate techniques (04) 505: Statistics Practical – I (02)	E1 506: Statistics in market research (04) OR E2 506: Categorical data analysis (04)	501: Research Methodology (04)			22	PG Diploma (after 3 Year Degree)
		Sem II	507: Statistics in healthcare and Clinical research (04) 508: Business Analytics (04) 509: Communication Skills and Soft Skills (02) 510: Elementary Time Series Analysis (02) 511: Statistics Practical – II (02)	E1 512: Six-sigma and Total Quality Management (04) OR E2 512: Elements of Data Science (04)		513: Statistical Project (04)		22	
Cum. Cr. For PGDiploma			28	8	4	4	-	44	
PG Diploma (44 Credits) after Three Year UG Degree									

Signature of HOD
Prof. S. P. Gite
Head of the Statistics Department

DR. S. P. GITE
Head Department of Statistics
University of Mumbai
Vidyanagari, Mumbai-400 098

Signature of Dean,
Prof. Shivram S. Garje
Science Faculty

Syllabus
Postgraduate Diploma in Applied Statistics with Software
(Semester I and Semester II)
The Academic year 2023-2024

Structure of the syllabus:

PGDASS is a one year (two semesters) program. The program consists of 44 credits. For each semester there are 22 credits. In semester I, "Research Methodology" of four credits is a compulsory course along with this there are three mandatory courses each of four credits and one practical course of two credits. One elective course of four credits can be selected out of two elective courses. In semester II, there are two mandatory courses each of four credits, two mandatory courses each of two credits and one practical course of two credits. One elective course of four credits can be selected out of two elective courses. In addition to this, students have to complete one statistical project of four credits.

Following is the table showing the proposed courses (mandatory and elective) to be covered in semester I and semester II of one year PGDASS program.

Semester I

Mandatory courses			
Course code	**Course Title**	**Credits**	**Total number of lectures**
501	Research Methodology	04	60
502	Basic Statistics	04	60
503	Applied regression analysis and analysis of variance	04	60
504	Applied Multivariate Techniques	04	60
505	Statistics Practical - I	02	60

Elective courses			
Course code	**Course Title**	**Credits**	**Total number of lectures**
E1 506	Statistics in Market research	04	60
E2 506	Categorical data analysis	04	60

Semester II

Mandatory courses			
Course code	**Course Title**	**Credits**	**Total number of lectures**
507	Statistics in health care and clinical research	04	60
508	Business analytics	04	60
509	Communication skill	02	30
510	Elementary time series analysis	02	30
511	Statistics Practical – II	02	60
512	Project	04	10 Guiding hours per group

Elective courses			
Course code	**Course Title**	**Credits**	**Total number of lectures**
E1 513	Six sigma and total quality management	04	60
E2 513	Elements of data science	04	60

PROGRAM LEARNING OUTCOMES

Aim of the program is to introduce Statistics and its applications to learners who haven't studied Statistics at major level. The program accentuates both the fundamentals and modern applications of statistics. The program is structured so that students will have enough knowledge of applied Statistics and necessary skills in Statistics for the employability in corporate. The program has the unique features like, research methodology, project, software use and adequate amount of courses in core as well as in applied Statistics.

On completion of this program learners will have,

PO 1)	Knowledge of ethical values to become a responsible Statistician.
PO 2)	Fair knowledge of fundamentals in statistics such as probability, statistical modeling, multivariate techniques etc.
PO 3)	Fluency in statistical computing using SPSS, MINITAB, R- language, Python.
PO 4)	Knowledge of reframing real situation information into statistical language, analyzing the data and to draw valid inferences based on it.

DETAILED SYLLABUS

Semester I

Mandatory Courses

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course Code and Name:**	501: Research Methodology
Total Credits:	04	**Total Marks:**	100
University assessment:	50	**College assessment:**	50
Pre requisite: Nil.			
Course outcomes: After completion of the course learners will, CO 1) Understand meaning of research. CO 2) Able to define research problem. CO 3) Know methods of collecting data statistically. CO 4) Know how to handle missing observations statistically in data. CO 5) Able to summarize data.			

CO 6) Able to visualize data.

CO 7) Able to use open access journals and databases.

CO 8) Know research ethics and ethical practices for future research.

MODULE I:	**(2 CREDITS)**
Unit 1:	Meaning of research, objectives of research, types of research, research process, research design, measurement and scaling, scaling techniques, types of data, Statistics in scientific Research: research design, types of statistical research: empirical, field experiments, laboratory experiments. Data collection methods: population, sample, sampling frame, sampling unit, determination of sample size, generating a random sample using probability sampling methods as, simple random sample, stratified random sample with different allocations, systematic random sample, multi-stage, multi-phase random sample, non-response and methods for recovering non-response. Network sampling.
Unit 2:	Data analysis: data editing, coding, imputation of missing values. Data summarization, histogram, bar diagrams, pie chart, frequency curve, stem-leaf display. Summary statistics: mean, median, mode, harmonic mean, geometric mean, trimmed mean, moving average, variance, coefficient of variation, mean deviation about median, mean deviation about mean, absolute mean, range, Box plot, violin plot, examples. Raw and central Moments upto fourth order, symmetric frequency curves, asymmetric frequency curves, skewness, measures of skewness, kurtosis, measures of kurtosis
MODULE II:	**(2 CREDITS)**
Unit 3:	Introduction to R Language: data entry, data editing, data extracting, simple algebra, matrix algebra, Visualization using R Language, Summarizing data using R language/SPSS/MINITAB.
Unit 4:	Report writing, Publication Ethics: Philosophy and ethics, scientific misconducts, plagiarism, duplicate and overlapping publications, best practices, conflicts of interest, violation of publication ethics, authorship and contributor ship, Open access publications, research databases: Web of Science, Scopus etc. different research Metrics: impact factor, h-index, g index, i10 index, cite score etc.

References:

- Agarwal, B. L. (2013): Basic Statistics. New age International.
- Anderson, D. R., Sweeny, D. J. and Williams-Rochester, T. A. (2002): Statistics for business and economics. Thomson Press.
- Beall, J. (2012): Predatory publishers and corrupting open access. Nature. 489,(7415), 179

- Bird, A. (2006) Philosophy of Science. Routledge.
- Buuren, Stef van (2012): Flexible imputation of missing data. Chapman and Hall.
- Chaddah, P. (2018): Ethics in competitive research: Do not get scooped: do not get plagiarize.
- Goon, A. M., Gupta, M. K. and Dasgupta, B. (1998): An outline of statistical theory. Volume I. The world press.
- Hanagal, D. D. (2017): Introduction to Applied Statistics: Non-Calculus Based Approach. Narosa Publishing House.
- Kothari, C. R. (2014): Research Methodology. Third edition, Wiley Eastern limited.
- Mandal, B. N. (2017) Introductory R for beginners. Brillion Publishing.
- Mood, A. M., Graybill, F. A. and Boes, D. C. (2005): Introduction to the theory of Statistics. Tata McGraw-Hill. Third edition.
- Muralidhar, K. Ghosh, A. and Singhvi, A. K. (2019): Ethics in science education. Research and Governance, Indian national science academy, new Delhi
- Patten, M. L. and Newhart, M. (2017): Understanding research methods: An overview of essentials. 10th edition. Routledge.
- Purohit, Gore, and Deshmukh (2008), Statistics Using R, Alpha Science International.

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course code and Name:**	502: Basic Statistics
Total Credits:	04	**Total Marks:**	100
University assessment:	50	**College assessment:**	50

Pre requisite: Set theory, Permutation and combination, limit, derivative and integration.

Course outcomes: After completion of the course learners will,

CO 1) Able to do primary analysis of the univariate data sets.

CO 2) Test the simple research hypotheses using parametric or nonparametric simple statistical methods as per situation.

MODULE I:	**(2 CREDITS)**
Unit 1:	Random experiment, sample space, concept of probability, examples, conditional probability, Bayes' theorem, random variable, probability function, distribution function, independence, expectation, examples on expectations, standard discrete and continuous distributions: Bernoulli, binomial, Poisson, negative binomial, exponential, normal, chi-square, students t, F, applications of central limit theorem.
Unit 2:	Testing of hypotheses: Statistical hypothesis, simple and composite hypothesis, Test statistic, critical region, acceptance region, probability of type 1 and type 2 errors. Power

	of test. Some standard parametric tests: Z test, t-test single sample and two sample, paired t-test. Problems using SPSS, MINITAB, R language.
MODULE II:	**(2 CREDITS)**
Unit 3:	Estimation of the parameters and parametric functions: need of estimation, notion of statistic, random sample, likelihood function, introduction to methods of estimation: maximum likelihood estimation, method of moments, finite sample and asymptotic properties of estimators. Confidence interval for mean, variance.
Unit 4:	Nonparametric tests: sign test, Wilcoxon's signed rank test, Wald-Wolfowitz run test, Mann-Whitney test, Chi-square test for independence, median test, Kruskal Walli's test, correlation coefficient, Spearman's rank correlation coefficient, Problems using SPSS, MINITAB, R language.

References:

- Anderson, D. R., Sweeny, D. J. and Williams-Rochester, T. A. (2002): Statistics for business and economics. Thomson Press.
- Hanagal, D. D. (2017): Introduction to Applied Statistics: Non-Calculus Based Approach. Narosa Publishing House.
- Hogg, R., Craig, A. T. and McKean, J. W. (1995): Introduction to Mathematical Statistics. Pearson. 6th Edition.
- Levin, R. I. and Rubin, D. S. (1998): Statistics for management. Pearson. 6th Edition.
- Kulkarni, M. B., Ghatpande, S. B. and Gore, S. D. (1999): Common Statistical tests. Satyajeet Prakashan, Pune.
- Mood, A. M., Graybill, F. A. and Boes, D. C. (1973): Introduction to the theory of Statistics. McGraw –Hill. 3rd Edition.
- Wackerly, D., Mendenhall, W. and Scheaffer, R. L. (2008): Mathematical Statistics with applications. Thomson. 7th Edition.

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course Code and Name:**	503: Applied regression analysis and analysis of variance
Total Credits:	04	**Total Marks:**	100
University assessment:	50	**College assessment:**	50

Pre requisite: Graphs, Equation of a line in two dimension, Some standard mathematical functions, exponential function, Sequences and series.

Course outcomes: After completion of the course learners will,

CO 1) Know concept and need of regression.

CO 2) able to fit appropriate regression models to real life data and select the best model.

CO 3) able to predict response value for given values of explanatory variables.	
MODULE I:	**(2 CREDITS)**
Unit 1:	Notion of Regression, need of regression, simple linear regression, interpretation of regression coefficients, estimation of regression coefficients, test of significance of regression coefficients, examples. Problems using SPSS, MINITAB, R language.
Unit 2:	Multiple linear regression, estimation, interpretation of parameters, testing of significance, transformation of variables, qualitative variables as predictors, regression diagnostics, selection of variables, analysis of collinear data. Problems using SPSS, MINITAB, R language.
MODULE II:	**(2 CREDITS)**
Unit 3:	Logistic regression, model, MLE of parameters, interpretation of parameters, multiple regressors, multinomial and ordinal logistic regression. Poisson regression, examples. Problems using SPSS, MINITAB, R language.
Unit 4:	One-way analysis of variance, two-way analysis of variance with and without interaction, multi-way analysis of variance, nested models, analysis of covariance, random effect models. Problems using SPSS, MINITAB, R language.

References:

- Chatterjee, S. and Hadi, A. S. (2012): Regression Analysis by Example. John Wiley. 5th Edition.
- Chatterjee, S., Handcock, M. S. and Simonoff, J. F. (1995): A Casebook for a first course in Statistics and data Analysis. John Wiley.
- Dielman, T. E. (2004): Applied Regression analysis: A second course on Business and Economics Statistics. Brooks/Cole. 4th Edition.
- Draper, N. R. and Smith, H. (1998): Applied Regression Analysis. John Wiley. 3rd Edition.
- Montgomery, D. C., Peck, E. A. and Vinning, G. G. (2012): Introduction to linear regression analysis. John Wiley. 5th Edition.
- Onyiah, L. C. (2008): Design and analysis of experiments: Classical and regression approach with SAS. CRC Press.
- Seber, George A. F. (2003) Linear Regression Analysis. John Wiley. 2nd Edition.

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course code and Name:**	504: Applied multivariate techniques
Total Credits:	04	**Total Marks:**	100
University assessment:	50	**College assessment:**	50
Pre requisite: Matrix theory. Operations on matrix such as addition, subtraction, multiplication etc. determinant, rank and inverse of a matrix.			

Course outcomes: After completion of the course learners will, CO 1) Have notion of multivariate data. CO 2) Able to analyze multivariate data. CO 3) Able to apply the advanced techniques for comparison or data reduction.	
MODULE I:	**(2 CREDITS)**
Unit 1:	The organization of data, need of multivariate analysis, multivariate data, multivariate data display and pictorial representation, detecting outliers and data cleaning, notion of bivariate, multivariate probability density function, introduction to multivariate normal distribution, assessing the assumption of multivariate normality, transformations to near multivariate normality. Hotelling's T^2 statistic and its applications to testing of hypotheses. Problems using SPSS, MINITAB, R language.
Unit 2:	One-way, two-way multivariate analysis of variance, Confidence Regions and simultaneous Comparisons of Component Means, Large Sample Inferences about a Population Mean Vector. Problems using SPSS, MINITAB, R language.
MODULE II:	**(2 CREDITS)**
Unit 3:	Multivariate Regression Model, Principal Component analysis, Factor Analysis. Problems using SPSS, MINITAB, R language.
Unit 4:	Cluster Analysis, Discrimination and Classification, Multi Dimensional Scaling. Problems using SPSS, MINITAB, R language.

References:

- Bishop, Y. M., Fienbeng, S. E. and Holland, P. W. (2007): Discrete Multivariate Analysis: Theory and Practice. Springer.
- Bryan, F. J. M. and Jorge A. (2017): Multivariate Statistical Methods: A primer. CRC Press. 4th Edition.
- Johnson, R. A. and Wichern, D. W. (2015): Applied Multivariate Statistical Analysis. 6th Edition. PHI Learning Private Limited.
- Husson, F., Sebastien L. and Pages, J. (2017): Exploratory Multivariate analysis by examples using R. CRC Press.
- Srivastava, M. S. (2002): Methods of Multivariate Statistics. John Wiley.
- Wolfgang, K. Hardle and Leopold Simar (2015): Applied Multivariate Statistical analysis. Springer. 4th Edition.

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course code and Name:**	505: Statistics Practical - I
Total Credits:	02	**Total Marks:**	50

University assessment:	50	College assessment:	--
Pre requisite: Courses 502, 503, 504			
Course outcomes: --			
MODULE I:			**(2 CREDITS)**
	Practicals based on PGDSST 502, PGDSST 503, PDSST 504 based on R Language, Python.		

Elective Courses

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	Course Code and Name:	E1 506: Statistics in market research
Total Credits:	04	Total Marks:	100
University assessment:	50	College assessment:	50
Pre requisite: Basic Mathematics and Statistics. Concepts and simple techniques. Set theory, tabulation of data.			
Course outcomes: After completion of the course learners will, CO 1) Learner will be able to understand the marketing data CO 2) Able to decide better marketing strategy. CO 3) Able to market related data analysis and draw better conclusions.			
MODULE I:			**(2 CREDITS)**
Unit 1:	Definition of marketing research and market research, need for marketing research, requirement of good marketing research, manager researcher relationship, competitive and complex nature of Indian markets, role of research in new product development, packaging, branding, positioning, distribution and pricing, ethics in Business Research. Planning the research Process - Steps in marketing Research. Techniques for identifying management problem and research problem. Meaning & types of research designs-exploratory, descriptive and causal.		
Unit 2:	Exploratory research designs, Sampling and data collection methods Causal research designs: Data collection methods Descriptive research design: Sampling methods, Types of scales, questionnaire design, Preparations research proposal		
MODULE II:			**(2 CREDITS)**
Unit 3:	Applications of Marketing Research - Introduction, Consumer Market Research, Business-to-Business Market Research, Product Research, Pricing Research, Motivational Research, Distribution Research, Advertising Research, Media research, Sales Analysis and Forecasting, Data Mining Recent Trends in Marketing research - Introduction, Marketing Information System and Research, Online Marketing Research, Research in Lifestyle Retail, Marketing Research		

	and Social Marketing, Rural Marketing Research, Trends in Services Marketing Research, Brand Equity Research, International Marketing and Branding Research Consumer segmentation techniques: Chi-square test of independence, Cluster analysis Customer discriminating technique: Discriminant analysis, Problems using SPSS, MINITAB, R language.
Unit 4:	Product positioning techniques: Snake chart, Benefit structure analysis, Multi-dimensional scaling technique, Factor analysis, **CH**i-squared **A**utomatic **I**nteraction **D**etector (CHAID). New product development technique: Conjoint analysis Report writing. Problems using SPSS, MINITAB, R language.

References:

- Aaker, D. A., Kumar, V., Leone, R. and Day, G. S. (2012) Marketing Research. John Wiley. 11th Edition.
- Burns, A. C. and Bush, R. F. (2005): Marketing Research with SPSS 13.0. Prentice. 5th Edition.
- Gibbons, J. D. and Chakraborti, S. (2010): Nonparametric Statistical Inference. CRC Press. 5th Edition.
- Hogg, R., Craig, A. T. and McKean, J. W. (1995): Introduction to Mathematical Statistics. Pearson. 6th Edition.
- Hanagal, D. D. (2017): Introduction to Applied Statistics: Non-Calculus Based Approach. Narosa Publishing House.
- Harper, W. B., Westfall, R. and Stasch, S. F. (1989): Marketing Research: Text and Cases. Richard d. Irwin. 7th Edition.
- Kinnear, T. C. and Taylor, J. R. (1995): Marketing Research: An applied Approach. McGraw Hill.
- Kulkarni, M. B., Ghatpande, S. B. and Gore, S. D.(1999): Common Statistical Tests. Satyajeet Prakashan.
- Malhotra, N. K. and Das, S. (2019): Marketing Research: An applied orientation revised Edition. Pearson. 7th Edition.
- Mood, A. M., Graybill, F. A. and Boes, D. C. (1973): Introduction to the theory of Statistics. McGraw –Hill. 3rd Edition.
- Nargundkar, R. (2003), Marketing Research Text & Cases. Tata McGraw Hills.
- Paul, E., Tull, D. S. and Albaum, G. G. (2009): Research for Marketing Decision. PHI. 5th Edition.

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course code and Name:**	E2 506: Categorical data analysis
Total Credits:	04	**Total Marks:**	100
University assessment:	50	**College assessment:**	50
Pre requisite: Basic Statistics and mathematics. Cross tabulation.			
Course outcomes: After completion of the course Learner will be able to analyze data which is categorical in nature.			
MODULE I:		**(2 CREDITS)**	
Unit 1:	Analysis of categorical data: Log linear models, contingency table, ways of comparing proportions, Chi-square test for independence, Linear trend alternative to independence,		
Unit 2:	Inference for two way contingency tables :Sampling distributions, testing goodness of fit, testing independence, large sample confidence intervals. Problems using Minitab, SPSS and R Language		
MODULE II:		**(2 CREDITS)**	
Unit 3:	Fisher's exact test for 2X2 contingency table Generalized linear models, logit models for categorical data. Problems using SPSS, MINITAB, R language.		
Unit 4:	Models for matched pairs: Comparison of dependent proportions : McNemar test Symmetry models, comparing marginal proportions.		

References:

- Alen Agresti (2013): An introduction to Categorical Data Analysis,2nd edition, Wiley.
- Cox D.R.(1970): The Analysis of binary data

EXAMINATION PATTERN

Each course will be evaluated in two components,

Component A] Continuous Internal Evaluation (CIE) and

Component B] Semester End Examination (SEE)

CIE will be of 50 marks which will include,

- one test of 20 marks of one and half hour duration and
- other 30 marks are composed of any one or combinations of group discussion, presentation, viva-voce, open notebook test, surprise test, assignments, data analysis etc. to be conducted by respective teacher.

SEE will be a theory examination of 50 marks of two hours duration based on entire syllabus. The question paper will consist of six questions of 10 marks each. Student should answer any five questions out of six questions.

SEMESTER-II

Mandatory courses

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course Code and Name:**	507: Statistics in healthcare and clinical research
Total Credits:	04	**Total Marks:**	100
University assessment:	50	**College assessment:**	50

Pre requisite: Basic Mathematics and Statistical techniques.

Course outcomes: After completion of the course learners will,

CO 1) Able to analyze the data especially of clinical trials and data collected in hospitals, clinics and diagnostic tests done in pathology laboratories.

MODULE I:	**(2 CREDITS)**
Unit 1:	Introduction to biostatistics, Clinical trial study designs: parallel and crossover designs. Drug development: phases of clinical trials. Randomization and blinding, Statistics in epidemiology, Sampling in research: probability and non-probability sampling, Simple random Sampling, convenience sampling, systematic sampling, stratified random sampling, cluster sampling, bootstrap sampling, sample size calculation.
Unit 2:	Statistical analysis plan (SAP) in clinical trials, Analysis of datasets: intent-to-treat, per-protocol. Data analysis in bioavailability (BA) and bioequivalence (BE) studies- PK/PD studies: data transformation, AUC, Cmax, Tmax, softwares (SAS, Stata, Win-Nonlin). Early stopping of clinical trials, placebo, causality assessment
MODULE II:	**(2 CREDITS)**
Unit 3:	Multiplicity and interim analysis, Survival analysis, Correlation and regression, Non-parametric tests for hypothesis testing: Fisher's exact test, Wilcoxon signed rank test, Wilcoxon rank sum test, Mann-Whitney 'U' test, Kruskal-Wallis test, Friedman test, Parametric tests for hypothesis testing: Analysis of variance (ANOVA), t-test, repeat measures ANOVA, Problems using SPSS, MINITAB, R language.
Unit 4:	Binary response data, odds ratio, relative risk, categorical data analysis, Meta-Analysis (Systematic review), Method comparison and evaluation, diagnostic tools: ROC curve analysis, Bland-Altman plot, sensitivity, specificity, negative predictive value, positive predictive value. Agreement: intraclass correlation coefficient, Kappa's inter-rater agreement, Cronbach's alpha. Problems using SPSS, MINITAB, R language.

References:

- Bernard, R. (2016): Fundamentals of Biostatistics. Cengage Learning. 8th Edition.
- Chap, T. L. (2003): Introductory Biostatistics. John Wiley.
- Chernick, M. R. and Friis, R. H. (2003): Introductory Biostatistics for the Health Sciences: Modern Applications Including Bootstrap. John Wiley.

- Davis, C. S. (2002): Statistical Methods for the Analysis of Repeated Measurements.
- Fleiss, J. L., Bruce, L. and Paik. M. C. (2003): Statistical Methods for Rates and Proportions.
- Petrie, A. (2005): Medical Statistics at a Glance. Blackwell Publishing. 2nd Edition.
- Shoukri, M. M. and Pause, C. A. (1999): Statistical Methods for Health Sciences. Second Edition.
- Tal, J. (2011): Strategy and Statistics in Clinical Trials (A Non-Statistician's Guide to Thinking, Designing, and Executing). Elsevier

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course Code and Name:**	508: Business Analytics
Total Credits:	04	**Total Marks:**	100
University assessment:	50	**College assessment:**	50

Pre requisite: Basic Mathematics and Statistical techniques

Course outcomes: After completion of the course learners will,

CO 1) Able to analyze the data related to a particular business.

CO 2) Able to identify Trend, and forecast using decision making criteria.

CO 3) Able to find out the reasons behind any challenges and solve them in better way.

MODULE I:	**(2 CREDITS)**
Unit 1:	Introduction to Business Analytics, basic concepts of forecasting and decision making and data analytics, Quantitative techniques of decision making: decision tree, break-even analysis, investment appraisal, critical path analysis, Qualitative techniques of decision making: SWOT analysis, PESTEL analysis, Six thinking hats technique, human mindset affecting implementation of decision, Statistical rules of decision making: maximin criterion, maximax criterion, minimax regret criterion, Laplace criterion.
Unit 2:	Bayesian approach to decision making: prior analysis, pre-posterior analysis, posterior analysis, sequential analysis, Quantitative time series techniques of forecasting: trend projection models, smoothing techniques, classical decomposition model, Box-Genkins model, Selection of right forecasting method. Qualitative methods of forecasting: Delphi Method, subjective probabilities method, market research.
MODULE II:	**(2 CREDITS)**
Unit 3:	Decision making under uncertainty, role of probability theory and statistical techniques, forecasting-based decision making. Characteristics of decision: unstructured or non-programmable decisions, structured or programmable decisions. Financial analytics, operational analytics, investment analytics

Unit 4:	Inventory management and introduction, inventory control, costs in inventory problems, techniques of inventory control with selective control (ABC analysis, usage rate and criticality), Techniques of inventory control with known demand and E.O.Q with uniform demand, production runs of unequal length, with finite rate of replenishment, problem of E.O.Q with shortage, Techniques inventory control with uncertain demand and buffer stock computation, stochastic problems and uniform demand. Techniques in inventory control with price discounts, break even analysis, marginal costing.

References:

- Mayes Timothy R. and Shack Todd. M (2006): Financial Analysis with Microsoft Excel.
- Martin Mindy C., Hansen Steven M. and Klingher Beth, (1996): Mastering Excel 2000. Premium Edition.
- Spyros, G. M., Steyan, C. W. and Hyndman, R. J. (1998): Forecasting : Methods & Applications. John Wiley.
- Hanke, J. E., Reitsch A. G. and Wichern , D. W.(2001): Business Forecasting. Prentice Hall. 7th Edition

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course Code and Name:**	509: Communication skills and soft skills
Total Credits:	02	**Total Marks:**	50
University assessment:	50	**College assessment:**	00

Pre requisite: English language

Course outcomes: After completion of the course learners will,

CO 1) Be oriented towards the functional aspect of language

CO 2) Have effective verbal and written communicators

CO 3) Have enhanced language proficiency.

CO 4) Able to develop effective writing skills.

CO 5) Enable to write in clear, concise and persuasive manner and to make them job-ready.

MODULE I: **(2 CREDITS)**

Unit 1:	Fundamentals of Grammar- Basic grammar and sentence construction, Concords, Articles, Confusing words, Spotting and avoiding grammatical and semantic errors. Letter writing- Parts, Structure, Layouts of formal letters, familiarizing with different formats of formal letters, Principles of Effective Letter Writing, Writing an impressive covering letter Curriculum Vitae- Understanding different formats of writing CV, Selecting the

	best-suited CV for the learner and creating it.
Unit 2:	Group Discussion- Types of GD, Methods and means to handle a GD Interviews- Grooming and preparation before an interview, Checklist and bio-data, how to be winsome and effective in an interview, Follow up Presentations- Verbal and PowerPoint presentations, how to be an effective communicator, essentials of a good PowerPoint, Presentation Skills

References:

- Allen, J. G. (2004): The Complete Q & A Job Interview Book. John Wiley.
- Brown, R. (2004): Making Business Writing Happen: A Simple and Effective Guide to Writing: Well, Allen and Unwin.
- Krantman, S. (2001): The Resume Writer's Workbook. Delmar.
- Nierenberg, A. H. (2005): Winning the Interview Game. Amacom.
- Rich, J. (2000): Great Resume: Get Noticed, Get Hired. Learning Express.
- Sinha, N. C. (2016): Fundamentals of English Language. Prabhat.

Webliography:

- http://www.onestopenglish.com
- www.britishcouncil.org/learning-learn-english.htm
- http://www.teachingeng1ish.org.uk
- http://www.usingenglish.com?
- Technical writing PDF (David McMurrey)
- http://www.bbc.co.uk/
- http://www.pearsoned.co.uk/AboutUs/ELT/
- http://www.howisay.com/
- http://www.thefreedictionary.com/

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course Code and Name:**	510: Elementary time series analysis
Total Credits:	02	**Total Marks:**	50
University assessment:	25	**College assessment:**	25
Pre requisite: Basic statistics and mathematics.			
Course outcomes: After completion of the course learners will, CO 1) Understand time series data. CO 2) Know, different time series processes. CO 3) Able to estimate the parameters of processes. CO 4) Able to select best model for the data.			
MODULE I:		**(2 CREDITS)**	

Unit 1:	Real life examples of time series, types of variation in time series, exploratory time series analysis, time plot, auto-covariance and auto-correlation functions. Exponential and Moving average smoothing. Holt -Winters smoothing. Forecasting based on smoothing. Problems using SPSS, MINITAB, R language.
Unit 2:	Auto regressive integrated moving average (ARIMA) processes, stationary processes, seasonal time series models, choice of AR and MA periods, estimation of process parameters, model comparisons, residual analysis and diagnostic checking. Problems using SPSS, MINITAB, R language.

- Brockwell, P. J. and Davis, R. A. (2003): Introduction to Time Series Analysis, Springer
- Chatfield, C. (2001): Time Series Forecasting, Chapman &Hall.
- Hamilton, N. Y. (1994): Time Series Analysis, Princeton University press.
- Kendall, M. and Ord, J. K. (1990): Time Series, 3rd Ed. Edward Arnold.

Shumway, R. H. and Stoffer, D. S. (2010): Time Series Analysis & Its Applications, Springer.

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course code and Name:**	511: Statistics Practical - II
Total Credits:	02	**Total Marks:**	50
University assessment:	50	**College assessment:**	--
Pre requisite: Courses 507, 508, 510			
Course outcomes: --			
MODULE I:			**(2 CREDITS)**
	Practicals based on PGDSST 507, PGDSST 508, PDSST 510 based on R Language / Python.		

Elective Courses

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course Code and Name:**	E1 512: Six-sigma and total quality management
Total Credits:	04	**Total Marks:**	100
University assessment:	50	**College assessment:**	50
Pre requisite: NIL			
Course outcomes: After completion of the course learners will, CO 1) Have knowledge of controlling quality of industrial products, Six sigma and ISO standard concepts. CO 2) Able to optimize output or yield of industrial process. CO 3) Able to improve operational efficiency.			

MODULE I:	(2 CREDITS)
Unit 1:	Introduction to Lean and six – sigma : Definition of Lean , 5 S in Lean , 7 wastes in lean, 5 principles of lean. Definition of six – sigma and definition of Lean six – sigma, DMAIC over view, Define phase : VOC, VOB, VOP, CTQ, COPQ, Project charter ,DPU , DPMO ,Yield , Brain Storming, SIPOC, Cause and Effect diagram
Unit 2:	Measure phase : Process definition , Process Mapping , Value Stream Mapping ,MSA, Process Capability Analysis , statistical techniques : Averages ,Dispersion
MODULE II:	**(2 CREDITS)**
Unit 3:	Analyse Phase: Correlation and Regression , Probability distributions , Determination of sample size ,Testing of Hypothesis, Improve Phase : Multi voting , Delphi Technique , Nominal group technique , Kaizen.
Unit 4:	Control Phase: Control plans, Poka Yoke , SPC :Control plans ,IMR chart , X – bar , R – charts, P – chart , C and U charts, Taguchi Techniques, ISO 9000. Problems using SPSS, MINITAB, R language.

References:

- Harry, M. and Schroeder, R. (2006): Six Sigma: The Breakthrough Management strategy revolutionizing the world's top corporations. Crown Business.
- Ishikawa, K. (1991): Guide To Quality Control. Asian Productivity Organization.
- Montgomery, D. C. (2012): Introduction to statistical quality control. John Wiley. 7th Edition.
- Pande, P. S., Neuman, R. P. and Cavanagh, R. R. (2002): The Six Sigma Way Team Fieldbook: An Implementation Guide for Process Improvement teams. McGraw Hill.
- Phadke, M. S. (1989): Quality Engineering Using Robust Design. Prentice Hall.
- Taguchi, G. (1986): Introduction to Quality Engineering: Designing Quality into Products and Processes. Quality Resources.

Programme Name:	Post Graduate Diploma in Applied Statistics with Software (PGDASS)	**Course Code and Name:**	E2 512: Elements of data science
Total Credits:	02	**Total Marks:**	50
University assessment:	25	**College assessment:**	25

Pre requisite: Multiple linear regression, logistic regression, introductory R language/ Python.

Course outcomes: After completion of the course learners will,

CO 1) Able to handle big data.

CO 2) Able to classify given data.

CO 3) Able to fit machine learning methods to real life data.

CO 4) Able to write Python programs to solve statistical problems.	
MODULE I:	**(2 CREDITS)**
Unit 1:	Introduction to Big data and Data Science, need of data science, data preparation, data handling, problems in large data, introduction to Data Mining,
Unit 2:	Data visualization using Tableau, Power BI, introduction to Python, different packages, Python programming for statistical techniques.
MODULE II:	**(2 REDITS)**
Unit 3:	Supervised, unsupervised learning, Classification techniques, CART, cross-validation, Random forests, XG Boost, Screening and Variable Selection, Support vector machine. Problems using R language, Python.
Unit 4:	Introduction to ridge regression, lasso regression, neural network. Applications of principal component analysis, clustering methods in unsupervised learning. Problems using R language, Python.

References:

- Breiman, L., Friedman, J. H., Olschen, R. A. and Stone, C.J. (1984): Classification of Regression Trees, Wadsowrth Publisher.
- Hand, D. J. , Mannila, H. and Smith, P. (2001): Principles of Data Mining, MIT Press, Cambridge.
- Hastie, T., Tibshirani, R. and Friedman, J. H. (2001): The elements of Statistical Learning: Data Mining, Inference & Prediction, Springer Series in Statistics, Springer- Verlag.
- James, G., Witten, D., Hastie, T. and Tibshirani, R. (2021): An introduction to Statistical Learning: with applications in R. Springer.
- Davy, C. ,Arno, D. B. and Meysman, Mohamed Ali (2016): Introducing Data Science, Manning Publications Co., 1st edition,
- Patil, D J , Hilary Mason, Mike Loukides, (2018): Ethics and Data Science. O' Reilly.

EXAMINATION PATTERN

Each course will be evaluated in two components,

Component A] Continuous Internal Evaluation (CIE) and

Component B] Semester End Examination (SEE)

CIE will be of 50 marks which will include,

- one test of 20 marks of one and half hour duration and
- other 30 marks are composed of any one or combinations of group discussion, presentation, viva-voce, open notebook test, surprise test, assignments, data analysis etc. to be conducted by respective teacher.

SEE will be a theory examination of 50 marks of two hours duration based on entire syllabus. The question paper will consist of six questions of 10 marks each. Student should answer any five questions out of six questions.

PROJECT EVALUATION

Project will be evaluated based on the project report submitted by the students and presentation based on the analysis of project as,

Guide's assessment	External judge's Assessment at the time of presentation	Individual Viva	Total
40 marks	40 marks	20 marks	100 marks

LETTER GRADES AND GRADE POINTS

Semester GPA / Program CGPA Semester / Program	**Percentage of Marks**	**Alpha-sign / Letter Grade Result**
09.00 – < 10.00	90.00 – 100	O (Outstanding)
08.00 – < 09.00	80.00 - < 90.00	A+ (Excellent)
07.00 – < 08.00	70.00 - < 80.00	A (Very Good)
06.00 – < 07.00	60.00 - < 70.00	B+(Good)
05.50 – < 06.00	55.00 - < 60.00	B (Above Average)
05.00 - < 05.50	50.00 - < 55.00	C (Average)
04.00 – < 05.00	40.00 - < 50.00	P (Pass)
Below 04.00	Below 40.00	F (Fail)
Absent	---	Absent

Syllabus
Post Graduate Diploma in Applied Statistics with Software
(PGDASS) (Sem. I & II)

Team for Creation of Syllabus

Name	College Name	Sign
Dr.(Mrs.) V. U. Dixit	Department of Statistics, University of Mumbai	VUDixit 22-8-23
Prof. Santosh P. Gite	Department of Statistics, University of Mumbai	
Dr. Alok D. Dabade	Department of Statistics, University of Mumbai	

Signature of HOD
Prof. S. P. Gite
Head of the Statistics Department

DR. S. P. GITE
Head Department of Statistics
University of Mumbai
Vidyanagari Mumbai 400 098

Signature of Dean,
Prof. Shivram S. Garje
Science Faculty

Appendix B

Justification for P.G. Diploma in Applied Statistics with Software

1.	Necessity for starting the course:	Now days Statistics is required to analyze data in every field. This course provides opportunity to any graduate with 12std mathematics to learn applied statistical techniques. The program is structured so that students will have fair enough knowledge of Applied Statistics and also necessary skills in statistics for the employability in corporate.
2.	Whether the UGC has recommended the course:	N.A.
3.	Whether the course have commenced from the academic year 2022-23.	The course has already commenced from the academic year 2006 and in academic year 2022-23, it is restructured under NEP, 2020.
4.	The course started by the university is self-financed, whether adequate number of eligible permanent faculties are available?	This course is self-financed. There are no permanent faculties. Experts from industry, company and academic field are invited on lecture basis.
5.	To give details regarding the duration of the course and is it possible to compress the course?	Duration of the program is one year (two semesters). It is not possible to compress the course.
6.	The intake capacity of each course and number of admissions given in the current academic year;	The intake capacity of program is 50. Number of admissions for the academic year 2022-23 is 16.
7.	Opportunity of Employability / Employment available after undertaking these courses:	There is a good opportunity for employment. Students have employability in corporate, multinational companies as a statistician, like finance, banks sector, pharmaceutical sector, IT sector etc.

Signature of HOD
Prof. S. P. Gite
Head of the Statistics Department

DR. S. P. GITE
Head Department of Statistics
University of Mumbai
Vidyanagari, Mumbai-400 098

Signature of Dean,
Prof. Shivram S. Garje
Science Faculty