Academic Council Meeting No. and Date : 2 / April 30, 2021

Agenda Number : 4 **Resolution Number : 4.6 and 4.22**

Vidya Prasarak Mandal's
B. N. Bandodkar College of Science (Autonomous), Thane

Syllabus for

Programme : Bachelor of Science

Specific Programme : STATISTICS

[F.Y.B.Sc. (Statistics)]

Revised under Autonomy

From academic year 2021 - 2022

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Preamble

The B.Sc Statistics programme is aimed to develop theoretical and analytical skills of the students so that they may be absorbed in the corporate world or able to pursue higher studies at the Master level in Statistics. The main objectives of the course are:

- To get introduced to some statistical concepts that are relevant in the interpretation of measurements made on individual, and in the interpretation of statistical study materials.
- to apply their knowledge and skills to be employed and excel in Statistics professional careers and/or to continue their education in Statistics and/or related post graduate programmes.
- To get Knowledge and understanding of basic statistical methods such as sampling and collecting data, probability, distributions, Regression Analysis.
- To gain Knowledge and understanding to confidently read statistics and apply statistical methods within their working environment.
- to be capable of managing Statistics projects with consideration of the human, financial and environmental factors.
- to work effectively as a part of a team to achieve a common stated goal.
- to communicate effectively with a range of audiences both technical and non-technical.
- to develop an aptitude to engage in continuing professional development.

The syllabus is aimed to achieve the objectives. The syllabus spanning three years covers the industry relevant courses. The students will be ready for the jobs available in different fields like:

- Statistician
- Analyst
- Biostatistician
- Actuaries
- Banking sector
- Risk Analyst
- Machine Learning and Artificial Intelligence
- Data Analytics
- Academics
- Government organizations like NSSO, NSO, ISS, SSC etc

And many others

The students will also be trained in communication skills and knowledge related to R software.

Eligibility :

Passed 12th standard (HSC) of Maharashtra State Board / CBSE / ICSE board or equivalent with Mathematics as one of the subjectcan adopt for F.Y.B.Sc with the subject combination of PMS.

Duration : 3 years

Mode of Conduct :

Statistics Practicals / Practicals related to R software/Offline lectures / Online lectures.

Program Specific Outcome

By the end of the programme, learners should be able to interpret, use and present information in written, graphical, diagrammatic and tabular terms. Enable efficient use of electronic devices to solve statistical problems. Develop the ability to use statistical knowledge and skills in other disciplines.

VPM's B. N. Bandodkar College of Science (Autonomous), Thane

F.Y.B.Sc. (Statistics)

Structure of Programme

Course Code	Course Title	No. of lectures	Credits
BNBUSST1T1	Descriptive Statistics – 1	**45**	**2**
BNBUSST1T2	Statistical Methods – 1	**45**	**2**
BNBUSST1P1	Based on Descriptive Statistics -1 & Statistical Methods-1	**30**	**2**
Total		**120**	**6**

Course Code	Course Title	No. of lectures	Credits
BNBUSST2T1	Descriptive Statistics – 2	**45**	**2**
BNBUSST2T2	Statistical Methods – 2	**45**	**2**
BNBUSST2P1	Based on Descriptive Statistics - 2 & Statistical Methods -2	**30**	**2**
Total		**120**	**120**

Semester I

Course Code	Course Title	Credits	No. of lectures
BNBUSST1T1	**Descriptive Statistics - 1**	2	

Course Outcomes: Upon completion of this course, students will acquire knowledge about and able to

- Understand technique of data collection and its presentation.
- Emphasize the need of numerical summary measures for data analysis.
- Understand contributions of various scientists in the field of Statistics.
- Apply Statistical concepts using R software.

Unit I :	**History Of Science:** **Introduction:** General History of Science, Aim and Scope of Statistics. **Contributions of following Scientists in the field of Statistics:** 1. Calyampudi Radhakrishna Rao (C.R.Rao). 2. Prasanta Chandra Mahalanobis (P.C. Mahalanobis). 3. Ronald Aylmer Fisher (R.A. Fisher) 4. Karl Pearson.	**15**
Unit II :	**Types of Data and Data Condensation:** **Types of data:** Qualitative and Quantitative data, Geographical, Time series data, Panel and Cross section data, Discrete and Continuous data. Types of Characteristics, Different types of scales: nominal, ordinal, interval and ratio. **Collection of Data**: Concept of population and sample. Finite and Infinite population, Notion of SRS, SRSWOR and SRSWR Primary data: Concepts of Questionnaire and a schedule, distinction between them, problems collecting data through the Questionnaire. Secondary data. Their Merits and Demerits. **Elementary Categorical Data Analysis**: Preparation of tables with two or three factors (variable/attributes) of classification, Verification for consistency. Requisites of a good table. Independence and Association for 2 attributes in a 2×2 table using Yule's coefficient of colligation and coefficient of association. Relationship between two coefficients.	**15**
Unit III :	**Classification of Data and Measure of Central Tendency:** **Classification and Data Presentation:** Frequency distribution of discrete and continuous variables. Cumulative frequency distribution. Graphical representation of frequency distribution by Histogram, Frequency polygon, Cumulative Frequency Curve and Ogives. Diagrammatic representation using Bar diagrams and Pie Chart. Stem and leaf diagram, Dot plot. **Measures of Central Tendency:** Concept of central tendency of data. Requirements of good measure. **Location averages:** Median, Mode, and Partition Values: Quartiles, Deciles, and Percentiles. Mathematical averages: Arithmetic mean (Simple mean, Weighted mean, Combined mean), Geometric mean, and Harmonic mean. Relation Between Arithmetic mean, Geometric mean, and Harmonic mean. Empirical relation between mean, median and mode. Merits and demerits of using different measures &their applicability.	**15**

Course Code	Course Title	Credits	No. of lectures
BNBUSST1T2	**Statistical Methods - 1**	2	

Course Outcomes: Upon completion of this course, students will acquire knowledge about and able to

- Solve probabilities using various definitions and rules of the probabilities.
- Understand the difference between discrete and continuous random variables.
- Understand mean, variance and other properties of some standard discrete distributions.
- Apply Statistical concepts using R software.

Unit I :	**Elementary Probability Theory :** **Probability:** Trial, Random experiment, Sample point and Sample Space. Definition of an event. Operation of events, Mutually exclusive and exhaustive events. Classical (Mathematical) and Empirical and Axiomatic definitions of Probability and their properties. Theorems on Addition and Multiplication of probabilities. Independence of n events (n =2,3), pairwise and mutual independence for three event Conditional probability, Bayes theorem(with proof) and its applications.	**15**
Unit II :	**Concepts of Discrete random variable :** **Univariate:** Random variable, Definition and properties of Probability Mass Function and Cumulative Distribution Function of discrete random variable and their graphical representation. Expectation of a random variable. Theorems on Expectation & Variance. Raw and Central moments(definition only) and their relationship (upto order four). Concepts of Skewness and Kurtosis. **Bivariate:** Definition of Bivariate random variable, Joint probability mass function of two Discrete Random Variables. Marginal and Conditional Probability Distributions, Independence of two random variables, Theorems on Expectation &Variance, Covariance and Coefficient of Correlation.	**15**
Unit III :	**Standard Discrete Probability Distributions:** **Discrete Distributions:** Degenerate distributions, Discrete Uniform distribution, Bernoulli distribution, Binomial distribution, Poisson distribution and Hypergeometric distribution. Derivation of their mean and variance. Recurrence relation for probabilities of Binomial and Poisson distributions. Binomial approximation to Poisson, Hyper geometric distribution approximation to Binomial.	**15**

Course Code BNBUSST1P1	Course Title **Descriptive Statistics - 1 and Statistical Methods -1 Practical**	Credits 2	No. of lectures
Practical No.	**Descriptive Statistics - 1 Practicals**		
1	Tabular Representation.		**3**
2	Theory of Attributes.		**3**
3	Classification of Data.		**3**
4	Diagrammatic and Graphical Representation.		**3**
5	Practical using R software: (i) Classification of Data and Diagrammatic representation. (ii) Measures of Central Tendency		**3**
	Statistical Methods- 1 Practicals		
6	Probability - I.		**3**
7	Probability - II.		**3**
8	Univariate Discrete Random variables.		**3**
9	Expectation.		**3**
10	Bivariate Discrete Random variables.		**3**
11	Standard Discrete Probability Distributions - 1		**3**
12	Standard Discrete Probability Distributions - 2		**3**
13	Practicals Using R software: Discrete uniform, Binomial, Poisson and Hypergeometric distribution.		**3**

References

Course Code	Course Title
BNBUSST1T1	Descriptive Statistics - 1

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Descriptive Statistics	Welling, Khandeparkar, Pawar, Naralkar	Manan Prakashan	----	----
2.	Descriptive Statistics	Shah R.J	Sheth Publications	8th	----
3.	Descriptive Statistics	Milan Gholba,Sudha Phatak, Madhavi Jardosh	Vipul Prakashan	1st	----
4.	Introduction to Mathematical Statistics	Hoel P.G.	Asia Publishing House	----	----
5.	Basic Statistics	Agarwal B.L.	New Age International Ltd	----	----
6.	Fundamentals of Mathematical Statistics	S.C. Gupta V.K. Kapoor	Sultan Chand and Sons	----	----

Course Code	Course Title
BNBUSST1T2	Statistical Methods – 1

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Statistical Methods	Welling, Khandeparkar, Pawar, Naralkar	Manan Prakashan	----	----
2.	Statistical Methods	Shah R.J	Sheth Publications	----	----
3.	Statistical Methods	Milan Gholba, Sudha Phatak	Vipul Prakashan	----	----
4.	Introduction to Mathematical Statistics	Hoel P.G.	Asia Publishing House	----	----
5.	Basic Statistics	Agarwal B.L.	New Age International Ltd	----	----
6.	Probability	Pitan Jim	Narosa Publishing House	----	----

Semester II

Course Code	Course Title	Credits	No. of lectures
BNBUSST2T1	**Descriptive Statistics – 2**	2	

On completion of the course, student will be able to–

- To analyse the data using Regression methods.
- Understand the concept of different Index numbers.
- Understand the shift of frequency curve.
- Understand concept of least square method.

Unit I :	**Measures of Dispersion, Skewness & Kurtosis:** **Concept of Dispersion**: Concept of dispersion. Requirements of good measure. Absolute and Relative measures of dispersion: Range, Quartile Deviation, Mean absolute deviation, Standard deviation. Variance and Combined variance, Raw and central moments upto fourth order and relations between them(with proof). Their properties. **Concept of Skewness and Kurtosis:** Measures of Skewness, Karl Pearson's, and Bowley's Coefficient of Skewness based on moments. Measure of Kurtosis, Box- Whisker Plot.	**15**
Unit II :	**Correlation and Regression Analysis:** **Correlation:** Scatter Diagram, Product moment correlation coefficient and its properties. Spearman's Rank correlation (With and without ties). **Regression Analysis:** Concept of linear regression. Principle of least squares. Fitting a straight line by method of least squares. Relation between Regression coefficients and Correlation Coefficient. **Fitting of Curves**: Fitting of curves reducible to linear form by transformation. Concept and use of coefficient of determination (R^2). Fitting a quadratic curve by method of least squares.	**15**
Unit III :	**Index Numbers:** **Index Numbers:** Index numbers as comparative tool. Stages in the construction of Price Index Numbers. Measures of Simple and Composite Index Numbers. Laspeyre's, Paasche's, Marshal-Edgeworth's, Dorbisch & Bowley's and Fisher's Index Numbers formula. Quantity Index Numbers and Value Index Numbers. Time reversal test, Factor reversal test, Circular test. Fixed base Index Numbers, Chain base Index Numbers. Base shifting, Splicing and Deflating. Cost of Living Index Number. Concept of Real Income based on Wholesale Price Index Number.	**15**

Course Code BNBUSST2T2	Course Title **Statistical Methods - 2**	Credits 2	No. of lectures
At the end of the course, a student will be able to: • A student will be able to test the null hypothesis and draw proper conclusions. • Study the concept of continuous Probability distributions. • Understand the nature of frequency curve. • Get the clear ideas about continuous random variables using various examples.			
Unit I :	**Continuous random variable :** **Basic concepts of continuous random variable.** Concept of Continuous random variable and properties of its Probability Density Function and Cumulative Distribution Function and their graphical representation. Expectation and variance of a random variable and its properties. Measures of location, dispersion, skewness and kurtosis. Raw and Central moments (simple illustrations).		**15**
Unit II :	**Continuous Probability Distributions:** Uniform Distribution, Exponential Distribution, Memory less property of Exponential Distribution and Normal Distribution Derivations of mean, median and variance for Uniform and Exponential distributions. Properties of Normal distribution and Normal Curve (without proof). Normal approximation to Binomial and Poisson distribution (statement only). Use of normal tables.		**15**
Unit III :	**Elementary topics on Estimation and Testing of hypothesis:** **Estimation:** Concept of Parameter, Statistic, Estimator , Estimate, Estimation and Bias. Standard error of an estimator. Central Limit theorem (statement only). **Sampling distribution :** Sampling distribution of an estimator , Sampling distribution of sample mean and sample proportion for large samples. Standard errors of sample mean and sample proportion. Point and Interval estimation of single mean, single proportion from sample of large size. **Statistical tests :** Concept of Hypothesis, Null and alternate Hypothesis, Types of errors, Critical region, Level of significance and P-value. Large sample tests (using central limit theorem, if necessary) • For testing specified value of Population mean • For testing specified value in difference of two Population Means • For testing specified value of Population Proportion. • For testing specified value of difference of Population Proportions.		**15**

Course Code BNBUSST2P1	Course Title **Descriptive Statistics - 2 and Statistical Methods -2 Practical**	Credits 2	No. of lectures
Practical No.	**Descriptive Statistics - 2 Practicals**		
1	Measures of Dispersion.		**3**
2	Correlation analysis.		**3**
3	Regression analysis.		**3**
4	Fitting of curve.		**3**
5	Index number – 1.		**3**
6	Index number – 2.		**3**
7	Practical using R (i) Correlation analysis and Regression analysis. (ii)Fitting of curve. (iii) Measures of Dispersion		**3**
	Statistical Methods – 2 Practicals		
8	Continuous Random Variables.		**3**
9	Uniform, Exponential and Normal Distributions.		**3**
10	Applications of Central Limit Theorem and Normal Approximation.		**3**
11	Estimation.		**3**
12	Testing of Hypothesis.		**3**
13	Large Sample Tests.		**3**
14	Practicals Using R (i) Uniform, Exponential and Normal Distributions. (ii) Estimation. (iii) Large Sample Tests.		**3**

References

Course Code	Course Title
BNBUSST2T1	Descriptive Statistics – 2

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Descriptive Statistics	Welling, Khandeparkar, Pawar, Naralkar	Manan Prakashan		----
2.	Descriptive Statistics	Shah R.J	Sheth Publications	8th	----
3.	Descriptive Statistics	Milan Gholba,Sudha Phatak, Madhavi Jardosh	Vipul Prakashan	1st	----
4.	Introduction to Mathematical Statistics	Hoel P.G.	Asia Publishing House		----
5.	Basic Statistics	Agarwal B.L.	New Age International Ltd		----
6.	Fundamentals of Mathematical Statistics	S.C. Gupta V.K. Kapoor	Sultan Chand and Sons		----
7.	Research Methodology	Kothari, C.R	Wiley Eastern Limited		

Course Code	Course Title
BNBUSST2T2	Statistical Methods – 2

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Statistical Methods	Welling, Khandeparkar, Pawar, Naralkar	Manan Prakashan	----	----
2.	Statistical Methods	Shah R.J	Sheth Publications	----	----
3.	Statistical Methods	Milan Gholba, Sudha Phatak	Vipul Prakashan	----	----
4.	Introduction to Mathematical Statistics	Hoel P.G.	Asia Publishing House	----	----
5.	Basic Statistics	Agarwal B.L.	New Age International Ltd	----	----
6.	Fundamentals of Mathematical Statistics	S.C. Gupta V.K. Kapoor	Sultan Chand and Sons	----	----
7.	Statistical Methods	Medhi J.:	New Age International Ltd	2nd	----

Evaluation Scheme

Internals

Internal Test	Project (Attending Seminars/Conf/workshop/any other and writing report on it)	Active Participation & Leadership qualities	Total
20	10	10	40

Internal Examination : Based on Unit 1 / Unit 2 / Unit 3

Duration : 1 Hour **Total Marks : 20**

	Answer the following	20
Q. 1		
Q. 2		
Q. 3		
Q. 4		

Theory Examination : Suggested Format of Question paper

Duration : 2 Hours **Total Marks : 60**

- **All questions are compulsory**

Q. 1	Answer ***any two*** of the following		**16**
	a	Based on Unit I	
	b	Based on Unit I	
	c	Based on Unit I	
Q. 2	Answer ***any two*** of the following		**16**
	a	Based on Unit II	
	b	Based on Unit II	
	c	Based on Unit II	
Q. 3	Answer ***any two*** of the following		**16**
	a	Based on Unit III	
	b	Based on Unit III	
	c	Based on Unit III	
Q. 4	Answer the following		
	a	State True or False :	**4**
	(i)	Based on Unit I/Unit II/ Unit III	
	(ii)	Based on Unit I/Unit II/ Unit III	
	(iii)	Based on Unit I/Unit II/ Unit III	
	(iv)	Based on Unit I/Unit II/ Unit III	
	b	Answer in one sentence:	**8**
	(i)	Based on Unit I/Unit II/ Unit III	
	(ii)	Based on Unit I/Unit II/ Unit III	
	(iii)	Based on Unit I/Unit II/ Unit III	
	(iv)	Based on Unit I/Unit II/ Unit III	

Marks Distribution and Passing Criterion for Each Semester

Theory					Practical		
Course Code	Internal	Min marks for passing	Theory Examination	Min marks for passing	Course Code	Practical Examination	Min marks for passing
BNBUSST1T1	**40**	**16**	**60**	**24**	BNBUSST1P1	**100**	**40**
BNBUSST1T2	**40**	**16**	**60**	**24**			

Theory					Practical		
Course Code	Internal	Min marks for passing	Theory Examination	Min marks for passing	Course Code	Practical Examination	Min marks for passing
BNBUSST2T1	**40**	**16**	**60**	**24**	BNBUSST2P1	**100**	**40**
BNBUSST2T2	**40**	**16**	**60**	**24**			

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