॥ अंतरी पेटवू ज्ञानज्योत ॥

NORTH MAHARASHTRA UNIVERSITY, JALGAON.

Syllabus for F.Y.B.Sc.

STATISTICS.

(W.e.f. Acd.Yr. 2002 - 2003)

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS FOR F.Y.B.Sc. (STATISTICS)

(With effect from Academic Year 2002-2003)

SYLLABUS STRUCTURE

The syllabi in STATISTICS at F. Y. B. Sc. class shall consist of two theory Papers and one practical paper as follows:-

(1) PAPER-I having the title "DESCRIPTIVE STATISTICS" and

(2) PAPER-II having the title "PROBABILITY AND PROBABILITY DISTRIBUTIONS"

(3) PAPER-III based on STATISTICS practicals.

The prerequisites for the theory papers are as follows:-

Prerequisites:- Elementary knowledge of the following concepts are expected:-

(i) Sets, operations on sets such as union, intersection, complementation.
(ii) Sequence and series.
(iii) Permutation and Combination.
(iv) Binomial theorem
(v) Differential Calculus
(vi) Integral Calculus

PAPER-I

DESCRIPTIVE STATISTICS

OBJECTIVES:- The main objective of this course is to acquaint students with some basic concepts in Statistics. They will be introduced to some fundamental methods of analysis of data. At the end of this course, the students are expected to be able –

- To tabulate data given in descriptive form and represent given data in graphical and diagrammatic form.
- To compute various measures of central tendency, dispersion, skewness and kurtosis.
- To compute the correlation coefficients and determine regression lines for ungrouped and grouped bi-variate data and interpret them.
- To analyze data pertaining to attributes and to interpret the results.

DETAILED CONTENTS OF SYLLABUS FOR PAPER-I

		Expected number of lectures & marks
1.	**FUNDAMENTAL CONCEPTS:**	**6 L, 6 M**
1.1	Meaning Scope and Limitations of Statistics.	
1.2	Statistical population, sample, sampling, objectives of sampling.	
1.3	Methods of sampling: Simple random sampling with and without replacement, Stratified sampling and Systematic sampling.	
2.	**DATA AND ITS TYPE:**	**8 L, 8 M**
2.1	Meaning of data and statistical data, Raw data, Quantitative & Qualitative data	
2.2	Variables & Attributes, Continuous & discrete data, Nominal & Ordinal data, Cross Sectional & time series data. Primary data & secondary data {designing a questionnaire, major sources of secondary data}.	
2.3	Different types of scale. nominal, ordinal, ratio and interval, Concept of Change of origin and scale.	
2.4	Examples and problems	
3	**PRESENTATION OF DATA.**	**10 L, 10 M**
3.1	Tabulation.- Meaning of table, Parts of table, Construction of table (up to three factors of classification)	
3.1	Diagrammatic representation of data. Simple, Multiple and subdivided bar diagrams, Pie diagram.	
3.2	Frequency distribution: Meaning of frequency, class, exclusive and inclusive classes, Open-end classes, class width, mid value, class boundaries and limits, cumulative frequency . Guidelines for constructing classes, Struges formula.	

3.3 Graphical representation of data:- Histogram, frequency curve, frequency polygon, ogives, steam & leaf chart, box plot.

3.4 Examples and Problems.

4 MEASURES OF CENTRAL TENDENCY: 12 L, 14 M

4.1 Meaning of centaral tendency , objectives, requirements of good measure of central tendency.

4.2 Measures of central tendency: A.M., G.M., H.M., weighted means, median, mode (definition computations for ungrouped and grouped data, merits and demerits)

4.3 Statement and proof of the following results:-
- (1) Sum of deviations of observations from their A.M. is zero.
- (2) Effect of change of origin and scale on A.M.
- (3) A.M. ≥ G.M. ≥ H.M.
- (4) Combined mean for k groups.

4.4 Use of appropriate measure of central tendency in different situations. Empirical relation among mean, median and mode.

4.5 Partition values: Quartiles, Deciles & Percentiles (Definition, Computations for ungrouped and grouped data.)

4.6 Examples and Problems.

5 MEASURES OF DISPERSION: 12 L, 15 M

5.1 Meaning and objective.

5.2 Absolute measures of dispersion:- range, quartile deviation (Q.D.), mean deviation (M.D.), variance, standard deviation (S.D.)

5.3 Relative measures of dispersion :- Coefficient of range, Coefficient of Q.D., coefficient of M.D., coefficient of variation.

5.4 Standard deviation for combined group (with proof).

5.5 Statement and proof of the following results:-
- (1) Effect of change of origin and scale on variance
- (2) Minimal property of mean deviation.
- (3) Minimal property of mean square deviation.

5.5.1 Ginis coefficient and Lorenz curve.

5.5.2 Examples and Problems.

6 MOMENTS, SKEWNESS AND KURTOSIS: 12 L, 12 M

6.1 Raw & central moments: Effect of change of origin & scale on moments.

6.2 Expression for central moments in terms of raw moments (with proof).

6.3 Skewness: Positive and negative skewness, symmetric distribution. Coefficient of skewness:- Bowleys coeff. of skewness , Karl Pearsons coeff. of skewness.

6.4 Kurtosis: Meaning, Types of Kurtosis:- leptokurtic, mesokurtic & platykurtic.

6.5 Measures of skewness and kurtosis based on moments.

6.6 Examples and Problems.

7 CORRELATION: 10 L, 10 M

7.1 Bivariate data, meaning of correlation, positive & negative correlation, Perfect correlation, scatter diagram.

7.2 Product moment correlation coefficient and its properties, interpretation

of the correlation coefficient.

7.3 Rank correlation: Spearman's rank correlation coefficient, derivation of the formula for rank correlation coefficient (without ties), rank correlation coefficient with ties (only formula without derivation).

7.4 Examples and Problems

8 REGRESSION: 15 L, 15 M

8.1 Meaning of regression, concept of linear and non-linear regression.

8.2 Concept of method of least squares.

8.3 Linear regression: Fitting of lines of regression by method of least squares.

8.4 Regression coefficients and its properties (Statement and proof).

8.5 Angle between the two lines of regression

8.6 Standard error of regression estimate, explained & unexplained variation and coefficient of determination

8.7 Non-linear regression: Fitting of non-linear curves of the type (i) $y = a+bx+cx^2$ (ii) $y=ax^b$ (iii) $y=ab^x$

8.8 Examples and problems

9. THEORY OF ATTRIBUTES: 8 L, 10 M

9.1 Notation, dichotomy classification, class frequency, order of class, positive class frequency, negative class frequency, ultimate class frequency, method of dot operator to find relationships among different class frequencies.

9.2 Fundamental set of class frequencies: Definition, determination whether a set of frequencies is fundamental set or not (two attributes).

9.3 Independence & association of two attributes. Yule's coefficient of association.

9.4 Examples and Problems.

BOOKS FOR REFERENCE:-

1 Applied General Statistics by Croxton F. E., Cowden D. J. and Klein S.

2 Statistical Methods Iowa state university press by Snedecor G. W. and Cochran W. G.

3 Fundamentals of Statistics Vol. I by A. M. Goon, M. K. Gupta and B. Dasgupta.

4 Theory and problems of statistics , Schaum's Publishing series by Spiegel M. R.

PAPER-II

PROBABILITY AND PROBABILITY DISTRIBUTIONS

Objectives: - The main objective of this course is to introduce the students to the axiomatic approach of probability, concepts of random variable, types of a random variable, probability mass function of a random variable, some Statistical measures such as mean, median, mode, standard deviation etc. relating to a random variable, moment generating function, cumulant generating function, and probability generating function of a random variable; some standard discrete probability distributions and their applications in real life situations.

By the end of the course, the students are expected to be able to do the followings: -

(i) To distinguish between random and non-random experiments.

(ii) To distinguish between discrete and continuous random variables.

(iii) To obtain probability mass function of a discrete random variable.

(iv) To apply a standard probability distribution for a given real life situation.

(v) To determine statistical measures for a given situation.

DETAILED CONTENTS OF SYLLABUS FOR PAPER-II

Expected No. Lectures & marks

1. CONCEPTS OF PROBABILITY — 20 L, 15M

1.1 Random and non-random experiments.

1.2 Definitions of the following terms :-
Outcome, Sample space (finite and infinite), Event, Occurrence of an event, Elementary event, Compound event, Complementary event, Exhaustive events, Mutually-exclusive events, favourable event, Equally-likely events, Sure event, Impossible event.

1.3 Classical definition of probability, Relative-frequency approach of probability, Axioms of probability

1.4 Addition theorem of probability upto three events (with proof using axioms of probability only)

1.5 Meaning of independent and dependent events, Conditional probability, Multiplication theorem of probability (with proof)

1.6 Partition of a sample space, Bayes theorem (with proof)

1.7 Examples and problems.

2. RANDOM VARIABLE — 5 L, 5 M

2.1 Concept of random variable, Discrete and continuous random variables, Sample space of a random variable.

(In further discussion only discrete random variable is expected.)

2.3 Function of a random variable

2.2 Examples and problems.

3. UNIVARIATE PROBABILITY DISTRIBUTION — 15 L, 18 M

3.1 Probability mass function of a random variable

3.2 Distribution function of a random variable

3.3 Statement of properties of a distribution function

3.4 Concept of symmetric random variable

3.5 Median and mode of a discrete random variable.

3.6 Definition of expected value of a random variable, Expected value of a function of a random variable.

3.7 Discussion of the following results with proof:-

(i) $E(K)=K$, where K is a constant, (ii) $E(aX+b) = aE(X)+b$, where a and b are constants, (iii) $E(E(X)) = E(X)$

(iv) $|E(X)| \leq E(|X|)$ (v) if $X \geq 0$, then $E(X) \geq 0$

3.8 Definition of variance and standard deviation of a random variable Concept of standardized random variable.

3.8 Discussion of the results with proof:-

(1) $Var(K) = 0$ where K is a constant

(2) $Var(aX + b) = a^2 Var(X)$, where a and b are constants.

4 BIVARIATE PROBABILITY DISTRIBUTION — 10 L, 12M

4.1 Definition of two-dimensional random variable.

4.2 Joint probability mass function of a two-dimensional random variable

4.3 Joint distribution function of two-dimensional random variable.

4.4 Statement of properties of joint distribution function.

4.5 Marginal probability mass function

4.6 Conditional probability mass function.

4.7 Independence of two random variables.

4.8 Examples and problems.

5. EXPECTATION, VARIANCE AND COVARIANCE OF TWO-DIMENSIONAL RANDOM VARIABLE — 10 L, 10 M

5.1 Expected value of two-dimensional random variable and its function.

5.2 Discussion of the following results with proof:-

(i) $E(aX+bY) = aE(X) + bE(Y)$

(ii) $E(aX.bY) = abE(X)E(Y)$, where X and Y are independent random variables.

(iii) $[E(XY)]^2 \leq E(X)^2 E(Y)^2$

5.3 Conditional expectation.

5.4 Definition of covariance of a random variable.

5.5 Laws of covariance (with proof)

5.6 Law of variance of linear combinations of two random variables with proof

5.7 Examples and problems.

6. MOMENT AND CUMULANT GENERATING FUNCTIONS — 8 L, 8 M

6.1 Definition of raw and central moments of a random variable
6.2 Statement of relations between raw and central moments.
6.3 Definition of moment generating function of a random variable.
6.4 Effect of change of origin and scale on moment generating function. Uniqueness property of moment generating function. Moment generating function of sum of two independent random variables.
6.5 Moment generating function of aX, aX+b , where a and b are constants.
6.6 Cumulant generating function :- Change of origin and scale, additive property of cumulant generating function, statement of relation between moments and cumulants.

STANDARD DISCRETE PROBABILITY DISTRIBUTIONS

7 DISCRETE UNIFORM DISTRIBUTION — 2 L, 6 M

7.1 Statement of probability mass function
7.2 Determination of mean and variance
7.3 Determination of moment generating function
7.4 Examples and problems

8. BERNOULLI DISTRIBUTION — 2 L, 4 M

8.1 Statement of probability mass function
8.2 Determination of mean and variance
8.3 Determination of moment generating function
8.4 Examples and problems

9. BINOMIAL DISTRIBUTION — 8 L, 8 M

9.1 Statement of probability mass function
9.2 Determination of mean and variance
9.3 Determination of mode
9.4 Determination of moment generating function
9.5 Statement and proof of reproductive (additive) property of binomial distribution.
9.6 Recurrence relation for central moments, cumulants and probabilities.
9.7 Examples and problems

10. HYPERGEOMETRIC DISTRIBUTION — 2 L, 6 M

10.1 Statement of probability mass function
10.2 Determination of mean and variance
10.4 Examples and problems

11 POISSON DISTRIBUTION — 8 L, 8 M

11.1 Statement of probability mass function
11.2 Determination of mean and variance
11.3 Determination of mode
11.4 Determination of moment generating function
11.5 Determination of cumulant generating function

11.6 Statement and proof of reproductive property of independent Poisson random variables (two random variables)
11.7 Recurrence relation for central moments and probabilities
11.8 Poisson approximation to binomial distribution
11.9 Examples and problems

BOOKS FOR REFERENCE

(1) Elementary Probability Theory with stochastic Processes
By Chung K. L.
Springer International Student Edition

(2) Elementary Probability Theory
By David Stirzaker
Cambridge University Press

(3) An Introduction to Probability Theory and its applications
By Feller W.
Wiley

(4) Probability
By Pitman, Jim
Narosa Publishing House.

PAPER III

STATISTICS PRACTICALS

Prerequisite: The knowledge of topics taught in the theory papers.

Objectives: The main objective of this course is to prepare the students to apply the statistical techniques learned by them to real life situations. At the end of this course, students are expected to be able to do the following: -

(1) Present the given data in tabular form.
(2) Present the given data in diagrammatic and graphical forms.
(3) Determine some elementary statistical measures by using algebraic and graphical methods.
(4) Decide the amount of linear relationship between two variables and determine functional form of relationship.
(5) Determine a functional relationship for non-linear relationship between two variables.
(6) Fit a specified probability distribution to given data.
(7) Draw a random sample from a specified probability distribution.

NOTES

(1) The total duration of practical examination shall be 5 (five) hours.

(2) The practical examination will consists of total 100 Marks. Of the 100 marks, 10 marks shall be reserved for viva-voce and 10 marks for practical journal. Thus the practical paper shall actually carry 80 marks.

(3) The examination shall be executed into two parts. Duration of each part shall be **TWO & HALF HOURS**.

(4) Each part will carry maximum 40 marks. A student will have to solve two questions out of four given questions. Each question will carry 20 marks.

(5) Students must complete all the practicals to the satisfaction of concerned teacher.

(6) Students must produce at the time of the practical examination the laboratory journal of practicals completed alongwith the completion certificate signed by the concerned teacher and the Head of the Department.

DETAILED CONTENTS OF SYLLABUS

PRACTICALS FOR PART -I

(1) Construction of tables from given raw information (Up to 3 factors of classification is expected, Students should be able to calculate and supply missing information in the tables.) **(1 P)**

(2) Construction of diagrams (simple, multiple, subdivided bar diagrams and pie diagram are expected). (1 P)

(3) Construction of frequency and cumulative frequency distribution from raw data (students should be able to decide the number of classes, class limits and class width).Construction of histogram, frequency curve, frequency polygon, ogives from the frequency distribution. (2 P)

(4) Computation of A.M., G.M. and H.M. for ungrouped and grouped data. (Problems based on only raw data and frequency distribution are expected.) (1 P)

(5) Computation of median, mode and quintiles (quartiles, deciles and percentiles) based on algebraic and graphical methods. (Problems based on only raw data and frequency distribution are expected.). (2 P)

(6) Computation of range, quartile deviation, mean deviation and standard deviation and their coefficients for ungrouped and grouped data (Problems based on only raw data and frequency distribution are expected). (2 P)

(7) Computation of raw and central moments, Karl person's and Bowley's coefficient of skewness, coefficient of skewness and kurtosis based on moments for ungrouped and grouped data (Problems based on only raw data and frequency distribution are expected.) (2 P)

PRACTICALS FOR PART -II

(8) Drawing of a random sample by using simple random sampling stratified random sampling and systematic random sampling. (1 P)

(9) Computation of product moment correlation coefficient and regression lines for ungrouped data (Problems based on only raw data are expected. Students should be able to determine explained and unexplained variations, standard error of estimate and estimation of unknown value by using regression equations). (2 P)

(10) Construction of bivariate frequency distribution, computation of product moment correlation coefficient and regression lines for grouped data. (3 P)

(11) Fitting of non linear curves (Students are expected to fit the curves i)$y=a+bx+cx^2$ (ii) $y= ax^b$ (iii) $y= ab^x$. (Problems based on only raw data are expected) (2 P)

(12) Fitting of binomial distribution and model sampling from binomial distribution.(For model sampling parameter values should be explicitly specified.). (2 P)

(13) Fitting of Poisson distribution and model sampling from Poisson distribution.(For model sampling parameter values should be explicitly specified.). (2 P)

Remark: - P indicates Practical period. One practical period is equivalent to 3 clock hours.