

UNIVERSITY OF PUNE  
Circular No. 215 of 1996

Subject :- Revised syllabus for F.Y. B.Sc.  
Statistics (Principal)

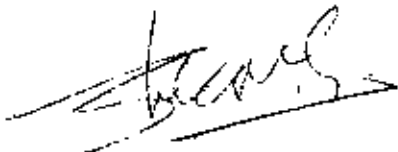
In pursuance of the decision taken by the University authorities, it is hereby notified for the information of all concerned that the revised syllabus for F.Y.B.Sc. Statistics (Principal) is as given in appendix 'A'.

The revised syllabus will be implemented from the Academic year 1996-97.

The Principals of all affiliated Colleges in Science where Statistics is taught are requested to bring the contents of this circular to the notice of all concerned teachers and students.

Ganeshkhind,  
Pune-411 007.  
Ref.No. CB/S/Stat/ 570  
Date : 7/6/1996  
12/6/96

Y  
Y  
Y  
Y  
Y

  
For Registrar

To,

The Principals of all affiliated Science Colleges.

Copy f.w.cs.to for information :-

- 1) The Dean, Faculty of Science.
- 2) The Members, of BOS in the Faculty of Science.
- 3) The Controller of Examinations.
- 4) The Director, BCUD
- 5) The Director, Competitive Exam. Centre
- 6) The System Analyst, Data Processing Unit.
- 7) The Dy. Registrar, (Admission)
- 8) The Dy. Registrar, (Examinations 1,2,3,4)
- 9) The Asstt. Registrar, (Exam.Co-ordination Unit)
- 10) The Asstt. Registrar (Exam.S. & T.Unit)
- 11) The Asstt. Registrar (Strong Room)
- 12) The Asstt. Registrar (Admission)
- 13) The Public Relation Officer
- 14) The Law Officer
- 15) The Uni.Sub-Centres, Adhmednagar.
- 16) The S.O. Eligibility
- 17) The S.O. Affiliation
- 18) The S.O. External

Authority :- ACB 32 PA 32/96  
B-32/96 dated 19.2.1996, 7.8/3/1996.

Syllabus For F.Y.B. <sup>Sc.</sup> Statistics to be implemented  
from June 1996.

---

Paper - I : Descriptive Statistics :

Objectives :

The main objective of this course is to students with some basic concepts in Statistics, will be introduced to some elementary Statistical methods of Analysis of data.

At the end of this course students are expected to be able to compute and interpret (i) various measures of central tendency, dispersion, skewness and kurtosis, (ii) to compute the correlation coefficient and regression coefficients from bivariate data and (iii) to compute the index numbers and also to tabulate and analyse data pertaining to attributes.

Contents :

1. Introduction to Statistics :

1.1 Definitions : Webster's Bowley's , Yule and Kendall's and Secrist's definitions of Statistics.

1.2 Importance of Statistics.

1.3 Scope of Statistics : In industry, biological Sciences, Medical Sciences, Economics, Social Sciences, Management Sciences.

1.4 Statistical organisations in India : CSO, ISI, NSS Bureau of Economics and Statistics, their names and functions.

2. Population and Sample :

2.1 Notion of a statistical population, types of populations and a sample from a population with illustrations.

2.2 Description of simple random sampling with and without replacement (SRSWR and SRSWOR), stratified random sampling, systematic sampling, cluster sampling, two stage sampling.

3. Types of Statistical Data :

3.1 Attributes : nominal scale and ordinal scale

Variables : discrete and continuous variables, raw data.

- 3.2 Classification : Discrete frequency distribution, continuous frequency distribution, inclusive and exclusive methods of classification, cumulative frequency distribution, relative frequency.
- 3.3 Graphical representation of statistical data : Histogram, frequency polygon and frequency curve, ogive curves.
- 3.4 Examples and problems.
4. Tabulation :
- 4.1 Definition of tabulation
- 4.2 Construction of statistical tables : Parts of table, rules of tabulation, uses of tabulation, Construction of tables with one, two and three factors of classifications.
- 4.3 Requirements of a good statistical table.
- 4.4 Examples.
5. Measures of Central Tendency :
- 5.1 Concept of central tendency of statistical data : statistical average. Requirements of a good statistical average.
- 5.2. Arithmetic Mean (A.M.) : Definition effect of change of origin and scale, combined mean of a number of groups, merits and demerits.
- 5.3 Geometric Mean (G.M.) : Definition , merits and demerits.
- 5.4 Harmonic Mean (H.M.) : Definition, merits and demerits.
- 5.5. Mode : Definition, formula for computation (without derivation), graphical method of determination of mode, merits and demerits.
- 5.6 Median : Definition , formula for computation (without derivation), graphical method of determination of median, merits and demerits.
- 5.7 Empirical relation between mean, median and mode.
- 5.8. Partition Values : Quartiles, Deciles and Percentiles.
- 5.9. Weighted Means : Weighted A.M., G.M. and H.M.
- 5.10. Situations where one kind of average is preferable to others.
- 5.11. Examples and problems.

6. Measures of Dispersion :

- 6.1 Concept of dispersion. Requirements of a good measure of dispersion.
- 6.2 Range : Definition, merits and demerits.
- 6.3 The Semi-interquartile range (quartile deviation).
- 6.4 Mean Deviation : Definition, merits and demerits, minimal property (without proof)
- 6.5 Mean Square Deviation : Definition, minimal property of mean square deviation, variance and standard deviation : Definition, merits and demerits, effect of change of origin and scale, statement of combined variance and standard deviation.
- 6.6 Absolute and relative measures of dispersion, coefficient of quartile deviation, coefficient of variation (C.V.)
- 6.7 Examples and Problems.

7. Moments :

- 7.1 Moments about an arbitrary constant
- 7.2 Raw moments ( $m_r$ ) for ungrouped and grouped data
- 7.3 Central moments ( $\mu_r$ ) for ungrouped and grouped data. Sheppard's corrections, effect of change of origin and scale.
- 7.4 Relations between central moments and raw moments.
- 7.5 Examples and Problems.

8. Skewness :

- 8.1 Concept of skewness of a frequency distribution, positive skewness, negative skewness, symmetric frequency distributions.
- 8.2 Bowley's coefficient of skewness : Proof that Bowley's coefficient of skewness lies between -1 to 1.
- 8.3 Karl Pearson's coefficient of skewness.
- 8.4 Measures of skewness based on moments.
- 8.5 Examples and Problems.

9. Kurtosis

- 9.1 Concepts of Kurtosis, Leptokurtic, Mesokurtic and Platykurtic frequency distributions.
- 9.2 Measures of Kurtosis based on moments.
- 9.3 Examples and Problems.

10. Correlation :

10.1 Bivariate data .

10.2 Concept of correlation between two variables, positive

10.3 Scatter diagram, conclusion about the type of correlation from scatter diagram.

10.4 Covariance between two variables ( $M_{11}$ ) : Definition, computation, effect of change of origin and scale.

10.5 Karl Pearson's coefficient of correlation ( $r$ ) : Definition, computation for ungrouped and group data and interpretation.

Properties (i)  $-1 \leq r \leq +1$  (with proof).

(ii) invariant to change of origin and scale (with proof).

10.6 Spearman's rank correlation coefficient : Definition, computation and interpretation (with and without ties), derivation of the formula for without ties.

10.7 Simple numerical examples

11. Regression :

11.1 Lines of regression, fitting of lines of regression by the least squares method.

11.2 Regression coefficients ( $b_{yx}$   $b_{xy}$ ) : definition, computation Properties : (i)  $b_{yx} b_{xy} = r^2$

(ii)  $b_{yx} b_{xy} = 1$

iii)  $b_{yx} = r \frac{y}{x}$ ,  $b_{xy} = r \frac{x}{y}$

iv) Effect of change of origin and scale

v) Angle between the two lines of regression.

- 11.3 Explained and unexplained variation, coefficient of determination.
  - 11.4 Nonlinear regression : i) Second degree curve, ii) exponential curve of type  $y = ab^x$ , fitting of such curves by least squares method.
  - 11.5 Examples and Problems.
  - 12. Theory of Attributes :
    - 12.1 Attributes : Notation , dichotomy, class-frequency, order of class positive class-frequency, negative class-frequency. Ultimate class-frequency, relationships among different class-frequencies ( upto two attributes).
    - 12.2 Concept of independence and association of two attributes.
    - 12.3 Yule's coefficient of association : Definition, computation, interpretation.
    - 12.4 Examples and Problems.
  - 13. Index Number :
    - 13.1 Need of index number, general problems in construction of index number.
    - 13.2 Computation and interpretation of price index numbers : Laspeyre's Paasche's and Fisher's, index numbers.
- Note : Numerical problems should have reference to real life situations.

Books Recommended

1. Goon, Gupta and Dasgupta  
Fundamentals of Statistics Vol. I & II.
2. S.P.Gupta  
Statistical methods.
3. Snedecor and Cochran  
Statistical Methods.
4. Croxton, F.E. and Cowden, D.J.  
Applied General Statistics.
5. Waiker and Lev.  
Elementary Statistical Methods.

## Discrete Probability and Probability Distributions.

## Objectives :

The main objective of this course is to introduce to the students the basic concepts of probability, axiomatic theory of probability, concept of random variable, probability distribution (univariate and bivariate) of discrete random variables, expectation and moments of probability distribution.

- By the end of the course students are expected to be able
- i) to distinguish between random and nonrandom experiments,
  - ii) to find the probabilities of events,
  - iii) to obtain a probability distribution of random variable (one or two dimensional) in the given situation, and
  - iv) to apply the standard discrete probability distributions to different situations.

## Contents :

1. Permutations and Combinations :
  - 1.1 Permutations of dissimilar objects taken  $r$  at a time (with or without repetitions).  $n P_r = \frac{n!}{(n-r)!}$  (without proof)
  - 1.2 Permutations of  $n$  objects not all of which are different.
  - 1.3 Permutations under simple restrictions (circular permutations are not expected).
  - 1.4 Combinations of objects taken from  $n$  objects. The notation  ${}^n C_r = \frac{n!}{r!(n-r)!}$  (without proof).
  - 1.5 Simple examples
2. Sample space and events :
  - 2.1 Experiments and random experiments. Ideas of deterministic and nondeterministic models.
  - 2.2 Definitions of (i) sample space ; (ii) discrete . . . . sample space : finite and countably infinite, (iii) event , (iv) elementary event, (v) certain event, and (vi) impossible event .
  - 2.3 Concept of occurrence of an event.

2.4 Union and intersection of two or more events. Occurrence of (i) at least one of the given events (ii) none of the given events, and (iii) all of the given events.

2.5 Mutually exclusive events, complementary events. (denote complement of event A by  $\bar{A}$ )

2.6 Symbolic representation of given events and description of events given in symbolic form.

2.7 Examples and Problems.

### 3. Probability

3.1 Classical definition of Probability.

3.2 Probability with reference to a finite sample space : Probability assignment approach. Probability of an event,

3.3 Equiprobable sample space, probability of an event.

3.4 Axioms of probability.

3.5 Probability of union of two events

$$P(A \cup B) = P(A) + P(B) - P(A \cap B) \text{ (with proof)}$$

Statements of extension of this result to union of three or more events.

3.6 To prove (i)  $P(\bar{A}) = 1 - P(A)$ , (ii) If  $A \subset B$ ,  $P(A) \leq P(B)$ .

3.7 Examples and Problems.

### 4. Conditional Probability and Independence of events :

4.1 Definition of independence of the two events

$$P(A \cap B) = P(A) \cdot P(B)$$

4.2 Pairwise independence and mutual independence for three events.

4.3 Definition of conditional probability of an event.

4.4 Multiplication theorem

$$P(A \cap B) = P(A) \cdot P(B|A)$$

4.5 Bayes theorem

4.6 Examples and Problems.



5. Univariate Probability Distributions : (Defined on finite sample space)
  - 5.1 Definition of discrete random variable.
  - 5.2 Probability mass function (p.m.f.) and cumulative distribution function (c.d.f)  $F(\cdot)$  of a discrete random variable , properties of c.d.f./d.f.
  - 5.3 p.m.f. of a function of a random variable.
  - 5.4 Mode and median of a univariate discrete probability distribution.
  - 5.5 Examples and Problems.
6. Bivariate Probability Distributions : (Defined on finite sample space)
  - 6.1 Definition of a two-dimensional discrete random variable, joint p.m.f. and joint d.f.
  - 6.2 Computation of probabilities of events in bivariate probability distributions.
  - 6.3 Concepts of marginal and conditional probability distributions.
  - 6.4 Independence of two discrete random variables.
  - 6.5 Probability distribution of functions of jointly distributed random variables.
  - 6.6 Examples and Problems.
7. Mathematical Expectation.
  - 7.1 Definition of expectation of a random variable, expectation of a function of a random variable.
  - 7.2 Definition of expectation in bivariate distributions.
  - 7.3 Theorems on expectation of sum and product of two jointly distributed random variables.
  - 7.4 Conditional expectation in bivariate probability distributions
  - 7.5 Definitions of mean, variance of univariate distributions. Effect of change of origin and scale on mean and variance.
  - 7.6 Definitions of conditional mean and variance in bivariate distributions.
  - 7.7 Definitions of covariance and correlation coefficient in bivariate distributions. Distinction between uncorrelated variables and independent variables.

- 7.8 Definition of raw, central and factorial moments of univariate probability distributions and their interrelations.
- 7.9 Definitions of raw and central moments of bivariate distributions.
- 7.10 Examples and Problems.

## 8 Some Standard Discrete Probability Distributions.

- 8.1 Bernoulli Distribution : p.o.f. mean, variance, moments, distribution of sum of independent identically distributed, Bernoulli variates.
- 8.2 Uniform discrete distribution on integers 1 to n : p.m.f., mean, variance, situations where this distribution arises.
- 8.3 Binomial Distribution : p.m.f.  $(P(r, n, p) = \binom{n}{r} p^r (1-p)^{n-r})$ , binomial variate  $X \sim B(n, p)$ , recurrence relation for successive probabilities, computation of probabilities of different events, mode of the distribution, mean, variance, moments, skewness (comments when  $p = 0.5$ ,  $0.5 < p < 0.5$ ), additive property of binomial variates, distribution of  $X$ , given  $X+Y = n$ , where  $X$  and  $Y$  are independent  $B(n, p)$  and  $B(n_2, p)$  variates.

### 8.4 Hypergeometric distribution:

$$P(X=r) = \frac{\binom{M}{r} \binom{N-M}{n-r}}{\binom{N}{n}}, \quad r=0, 1, 2, \dots, n \text{ or } M \text{ whichever is smaller}$$

p.m.f. , computation of probabilities, situations where this distribution is applicable, binomial approximation to hypergeometric probabilities, mean and variance of the distribution.

### 8.5 Examples and Problems.

#### BOOKS RECOMMENDED

1. Hogg, R.V. and Craig, R.G.  
Introduction to Mathematical Statistics.
2. Hoel, P.G.  
Introduction to Mathematical Statistics.
3. Feller, W.  
Introduction to Probability Theory and its Applications,  
Vol. I.
4. Mood, A.M., Graybill, F.A., Boes, D.C.  
Introduction to Theory of Statistics,
5. Meyer, P.L.  
Introduction to Probability and Statistical Applications.