Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Statistics

(Faculty of Science & Technology)

F.Y.B.A. (Statistics)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: B. A. (Statistics)

Preamble of the syllabus:

The word *Statistics* is used in different ways in different contexts. To a cricket fan, Statistics is the information about runs scored or wickets taken by a player. To the manager of a manufacturing unit, Statistics may be the information about the process control. To a medical researcher investigating the effects of a new drug, Statistics are evidence of research efforts. To a college student, Statistics are the grades or marks scored in a course. Thus, in all these illustrations Statistics word refers to quantitative data in the area under study. Statistics as a subject is an important branch of knowledge and is devoted to various techniques of collection, presentation, analysis and interpretation of data. It is a science of learning from data. Statistics provides tools for making decisions when conditions of uncertainty prevail. Hence these tools and techniques are used in almost all fields. Statistics is indispensable for people working in fields like agriculture, business, management, economics, finance, insurance, education, biotechnology and medical science etc. Since last two decade, with the help of computers large amount of data can be handled and more sophisticated statistical techniques can be used in an effective manner. Knowledge of different aspects of Statistics has become crucial. There is a continuous demand for statisticians in every field – education, industry, software and research.

The syllabus of the three Year B. A. degree course in Statistics is framed in such a way that the students at the end of the course can apply judiciously the statistical tools to a variety of data sets to arrive at some conclusions. Statistics can be divided into two broad categories, (1) exploratory statistics or descriptive statistics, which is concerned with summarizing data and describing these data, and (2) confirmatory statistics or inferential statistics, which is concerned with making decisions about the population based on the sample. Up to higher secondary school, students are mostly exposed to descriptive statistics. At the first year a student can take any one of the four subjects related statistics, such as Statistics, Applied Statistics, Mathematical Statistics and Statistical Prerequisites. If the student continues with these subjects at the second year and third year, it is expected that at the end of the degree course a student is able to apply the statistical tools to real life data.

Introduction: B. A. degree program is three yearsof duration, with semester pattern for the first, second and third year. The structure of **Bachelor of Arts (B.A.) is as follows.** The student joining the First Year B.A. Course has to take six subjects from 13 groups. The student cannot take more than one subject from one group. There are four subjects related to statistics. These are Statistics (Group L), Applied Statistics (Group L), Mathematical Statistics (Group J) and Statistical Prerequisites (Group K).

Structure of the Syllabus:

Structure of the subject for first and subsequent three years and the pattern of examination and question papers are as specified below.

Structure of F. Y. B. A. Statistics/Mathematical Statistics/Applied Statistics/ Statistical-Prerequisites

Semester	Subject	Subject code	Title	Credit	Marks
I	Statistics	ST- 13871	Descriptive Statistics I	3	100
	Mathematical Statistics	ST- 13271	Discrete Probability and Probability Distributions	3	100
	Applied Statistics	ST-14171	Descriptive Statistics I	3	100
	Statistical Pre-requisites	ST-13571	Descriptive Statistics I	3	100
II	Statistics	ST- 13872	Descriptive Statistics II	3	100
	Mathematical Statistics	ST- 13272	Discrete Probability Distributions	3	100
	Applied Statistics	ST-14172	Descriptive Statistics II	3	100
	Statistical Pre-requisites	ST-13572	Descriptive Statistics II	3	100

SEMESTER-I

ST- 13871 :Descriptive Statistics-I

Objectives:

The main objective of this course is to acquaint students with some basic concerns of statistics. They will be introduced to some elementary statistical methods of analysis and at the end of this course students are expected to be able:

1. To prepare frequency distribution and represent it by graphically with the help of tables.

2. To compute various measures of central tendency, dispersion, moments, Skewness, Kurtosis andtointerpret them.

3. To distinguish between random and non-random experiments.

Note: Mathematical derivations and proofs are not expected

1.Introduction to Statistics: **(5L)**

1.1Meaning of Statistics as aScience.Importance ofStatistics.

1.2Scope of Statistics: In the field of Industry, Biological sciences, Medical sciences, Economics, Social Sciences, Management sciences, Agriculture, Insurance, Information technology, Education andPsychology.

1.3Statistical organizations in India and their functions: CSO, ISI, NSS, IIPS (Devnar, Mumbai), Bureau of Economics andstatistics.

2.PopulationandSample: **(5L)**

2.1Notion of a statistical population: Finite population, infinite population, homogeneous population and heterogeneous population. Notion of a sample and a randomsample

2.2Methods of sampling (Description only): Simple random sampling with and without replacement (SRSWR and SRSWOR) stratified random sampling, systematic sampling, illustrations for each sampling method.

3.Types ofcharacteristics: **(10L)**

3.1Attributes: Nominal scale, ordinal scale,

3.2Variables: Interval scale, ratio scale, discrete and continuous variables, difference between linear scale and circular scale

3.3Types ofdata:

(a) Primary data, Secondarydata

(b) Cross-sectional data, time series data, directionaldata.

3.4Classification: Raw data and its classification, inclusive and exclusive methods of classification, open end classes,ungrouped frequency distribution, Sturges' rule, grouped frequency distribution, cumulative frequency distribution,and relative frequencydistribution.

3.5Representation of data: Bar Diagrams, Pie-Diagram, Histogram, frequency polygon, frequency curve and Ogive curves.

4.Statistical Averages: **(10L)**

  4.1 Concept of central tendency of statistical data, Statistical averages, characteristics of a good statistical average.

  4.2Arithmetic Mean (A.M.): Definition, effect of change of origin and scale, combined mean of a number of groups, merits and demerits, trimmed arithmeticmean.

  4.3Mode and Median: Definition, formulae (for ungrouped and grouped data),Empirical relation between mean, median and mode (withoutproof).

  4.4Partition Values: Quartiles, Deciles and Percentiles (for ungrouped and grouped data), Box plot.Situations where one kind of average is preferable to others.

5.Measures ofDispersion: **(8 L)**

  5.1Concept of dispersion, characteristics of good measure of dispersion.

  5.2Range, Semi-interquartile range (Quartile deviation): Definition.

  Mean deviation: Definition, statement of minimalproperty (without proof).

  Mean squared deviation: Definition, minimal property of mean squared deviation (with proof).

  5.3Variance and standard deviation: Definition, effect of change of origin and scale (with proof).Combined variance for twogroups with illustrative examples.

  5.4Measures of dispersion for comparison: coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation(C.V.)

6.Moments, SkewnessandKurtosis: **(10L)**

  6.1Moments:Raw moments $(m'_r)$for ungrouped and groupeddata, Central moments (m_r) for ungrouped and grouped data, Effect of change of origin and scale on central moments(with proof).Relations between central moments and raw moments, upto 4-th order (without proof).

  6.2Skewness: Concept of skewness of frequency distribution, positiveskewness, negative skewness, symmetric frequencydistribution.

  6.3Bowley'scoefficientofskewness:Bowley'scoefficientofskewnessliesbetween −1 to1(with proof), interpretation using Box plot.Karl Pearson's coefficient ofskewness.

  6.4Measures of skewness based on moments ($\hat{\beta}_1$,$\hat{\gamma}_1$).Comment on type of skewness using ($\hat{\beta}_1$,$\hat{\gamma}_1$).

  6.5Kurtosis: Concepts ofkurtosis,leptokurtic,mesokurticandplatykurticfrequency distributions.Measures of kurtosis based on moments($\hat{\beta}_2$,$\hat{\gamma}_2$).Comment on type of skewness using ($\hat{\beta}_2$,$\hat{\gamma}_2$).

Recommended Books:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
2. Ghosh, J. K. and Mitra, S. K., Parthsarthi, K. R. (1993). Glimpses of India's Statistics Heritage, Wiley publishing Co.
3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, The World Press Pvt. Ltd., Calcutta.

4. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
5. Gupta, S. C. and Kapoor, V. K. (1997). Fundamentals of Applied Statistics, Third Edition, Sultan Chand and Sons Publishers, New Delhi.
6. Neil A. Weiss, (2016). Introductory Statistics, Tenth Edition, Pearson.
7. Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, New Delhi.
8. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentce Hall of India, New Delhi.
9. Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East- West Press.

SEMESTER-II

ST- 13872 :Descriptive Statistics-II

Objectives: The main objective of this course is to acquaint students with some basic concepts in statistics. Atthe end of this course students are expected to be able,
1) To compute correlation coefficient, interpret its value.
2) To computer regression coefficient, interpret its value and use in regression analysis.
3) To compute various index numbers.

1.Correlation: **(12L)**
  1.1Bivariate data, Scatter diagram andinterpretation.Concept of correlation between two variables, positive correlation, negative correlation, nocorrelation.
  1.2Covariance between two variables (m_{11}): Definition, computation, effect of change of origin andscale(with proof).
  1.3Karl Pearson's coefficient of correlation(r): Definition, computation for ungrouped data and interpretation.Properties(with proof): i) $-1 \le r \le 1$ ii) Effect of change of origin & scale.
  1.4Spearman's rank correlation coefficient: Definition, derivation of formula, computation and interpretation (without ties). In case of ties, compute Karl Pearson's correlation coefficient between ranks. (Spearman's rank correlation coefficient formula with correction for ties notexpected.)

2.LinearRegression: **(10L)**
  2.1Concept of regression, lines of regression, fitting of lines of regression by the leastsquares method, interpretation of slope and intercept.
  2.2Regression coefficient (byx, bxy): Definition, computation, properties (with proof):
  i)byx*bxy=r^2, ii)byx*bxy$\le$1, iii) algebraic sign of regression coefficients are same,
  iv) Effect of change of origin and scale, v) Angle between the two lines of regression(only statement),vi)byx=rσyσx, vii) bxy=rσxσy.
  2.3Explained and unexplained variation, coefficient of determination with uses.
  (To find mean of X and mean of Y from the two lines of regression.To find regression coefficients and correlation coefficient from the two lines of regression. To estimate the value of one variable for the given value of other variable using proper line of equation.)

3.**Non-linear Regression:**   **(8L)**

   3.1Concept of non-linear regression. Necessity and importance of drawing second degree curve.

3.2Fitting of second degree curve$Y = a + b X + cX^2$,by the method of least squares.

3.3Fitting of exponential curves of the type $Y = a\ b^X$ and $Y = aX^b$by the method of least squares.

4.**IndexNumbers:**   **(10L)**

   4.1Introduction.Definition and Meaning.Problems/considerations in the construction of indexnumbers.

   4.2Various types of Index Numbers like Human Development Index, Happiness Index BSE sensitivity Index.

   4.3Unweighted price index numbers using: i) Aggregate method   ii) Average of price relativesmethod (A. M. or G. M. to be used as average).

   4.4Weighted price index numbers using aggregate method:Laspeyre's, Paasche's, Fisher's Formulae, cost of living index numbers.

   4.5Consumer price index number: Considerations in its construction.Methods of construction of consumer price index number:

   i) family budgetmethod

   ii) aggregate expenditure method.

   4.6 Shifting of base, splicing, deflating, purchasingpower.

5.**TheoryofAttributes:**   **(8L)**

   5.1Attributes: Concept of a Likert scale, classification, notion of manifold classification, dichotomy, class- frequency, order of a class, positive class-frequency, negative class frequency, ultimate class frequency, relationship among different class frequencies (up to three attributes), and dot operator to find the relation between frequencies, fundamental set of classfrequencies.
   5.2Consistency of data upto 2attributes.Concepts of independence and association of twoattributes. Yule's coefficient of association (Q), $-1 \le Q \le 1$,interpretation.

Recommended Books:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
2. Ghosh, J. K. and Mitra, S. K., Parthsarthi, K. R. (1993). Glimpses of India's Statistics Heritage, Wiley publishing Co.
3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, The World Press Pvt. Ltd., Calcutta.
4. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
5. Gupta, S. C. and Kapoor, V. K. (1997). Fundamentals of Applied Statistics, Third Edition, Sultan Chand and Sons Publishers, New Delhi.
6. Neil A. Weiss, (2016). Introductory Statistics, Tenth Edition, Pearson.
7. Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, New Delhi.
8. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on

PC. Prentce Hall of India, New Delhi.
9. Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East- West Press.

Reference Websites:

1. www.stats.unipune.ac.in (100 Data sets for Statistics Educationby Dr. Anil P. Gore, Dr. Mrs. S. A. Paranjpe and Madhav B. Kulkarni available in ISPSfolder).
2. www.freestatistics.tk(National StatisticalAgencies)
3. www.psychstat.smsu.edu/sbk00.htm(Onlinebook)
4. www.bmj.bmjournals.com/collections/statsbk/index.shtml
5. www.statweb.calpoly.edu/bchance/stat-stuff.html
6. www.amstat.org/publications/jse/jse-data-archive.html(International journalon teaching and learning ofstatistics)
7. www.amstat.org/publications/chance(Chancemagazine)
8. www.statsci.org/datasets.html(Datasets)
9. www.math.uah.edu/stat(Virtual laboratories inStatistics)
10. www.amstat.org/publications/stats(STATS : the magazine for students of Statistics)
11. www.stat.ucla.edu/cases(Case studies inStatistics).
12. www.statsoft.com
13. www.statistics.com
14. www.indiastat.com
15. www.unstat.un.org
16. www.stat.stanford.edu
17. www.statpages.net
18. www.wto.org
19. www.censusindia.gov.in
20. www.mospi.nic.in
21. www.statisticsofindia.in