Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B^{++}'Grade (CGPA2.96)

Name of the Faculty: Science & Technology

(As per New Education Policy 2020)

Syllabus: Statistics

Name of the Course: B.Sc. I (Sem. I &II)

(Syllabus to be implemented from June 2024)

Semester-wise Structure for

B. Sc. Statistics (Honors/Research) Programme

as per NEP-2020

(w.e.f. – June 2024)

B.Sc. Part-I (Semester-I) Statistics						
Course Type	**Course Code**	**Course Title**	**Credits**	**Teaching hours/week**		
				T	**P**	**Total**
DSC	**DSC-1**	Descriptive Statistics	**2**	**2**	**--**	**2**
	DSC-1 (P)	Statistics Practical-I	**2**	**--**	**4**	**4**
OE	**OE-1**	Fundamentals of Statistics	**2**	**2**	**--**	**2**
SEC	**SEC-1**	Data analysis using MS-EXCEL-I	**2**	**--**	**4**	**4**
B.Sc. Part-I (Semester-II) Statistics						
DSC	**DSC-2**	Elementary Statistics	**2**	**2**	**--**	**2**
	DSC-2 (P)	Statistics Practical-II	**2**	**--**	**4**	**4**
OE	**OE-2**	Sample Survey Techniques	**2**	**2**	**--**	**2**
SEC	**SEC-2**	Data analysis using MS-EXCEL-II	**2**	**--**	**4**	**4**

B. Sc. Part-I (Statistics) Semester-I

DSC-1	Theory	DESCRIPTIVE STATISTICS	Credits: 02 Hours: 30

Course Objectives:

1. To provide knowledge of data types, data collection techniques and data presentation.
2. To describe measures of central tendency and dispersion.
3. To discuss appropriate use of measures of central tendency and dispersion.

Course Outcomes:

After successful completion of this course, students are expected to:

1. Present the data diagrammatically and graphically.
2. Compute and interpret various measures of central tendency.
3. Summarize the information in the data using summary measures.
4. Compute and interpret various measures of dispersion.
5. Compute and interpret moments, skewness and kurtosis.

Course Content

Unit-1: **Classification and Measures of Central Tendency** **(15 hrs.)**

1.1 Types of Data: Meaning and scope of Statistics, concepts of a statistical population and sample from a population, qualitative and quantitative data, discrete and continuous data, Measurement scales - nominal, ordinal, ratio and interval scales.

1.2 Collection and Presentation of Data: Primary and Secondary data, Methods of collection for primary data, sources of secondary data. Classification of Individual data: ungrouped and grouped frequency distribution. Method of classification: inclusive and exclusive, open end classes, cumulative frequency distribution and relative frequency distribution.

1.3 Diagrammatic and graphical representation of data: Pie diagram, line diagram, Bar diagrams, histogram, frequency polygon, frequency curve and Ogive curves. Stem and leaf chart. Box plot.

1.4 Measures of Central Tendency: Concept of central tendency, Mathematical and positional averages, requirements of good average.

1.5 Mathematical averages: Arithmetic Mean (AM): Definition, effect of change of origin and scale, Deviation of observations from A.M., Mean of pooled data, merits and demerits, Weighted arithmetic mean. **Geometric Mean (G.M.):** Definition, G. M. of pooled data (for two groups), merits and demerits, uses of G.M. **Harmonic Mean (H.M.):** Definition, merits and demerits. Illustrative examples.

1.6 Positional Averages: Median: Definition, Derivation of formula for median of grouped frequency distribution, merits and demerits, Partition values: Quartiles, Deciles and Percentiles (for ungrouped and grouped data). **Mode:** Definition, Derivation of formula for mode of grouped frequency distribution, merits and demerits, empirical relation between mean, median and mode (without proof). Determination of positional averages graphically. Illustrative examples.

Unit-2: Measures of Dispersion, Skewness and Kurtosis (15 hrs.)

2.1 Measures of Dispersion: Concept of dispersion, Absolute and Relative Measures of dispersion, characteristics of good measures of dispersion.

2.2 Range and Quartile Deviation: Range: Definition, Coefficient of Range.
Quartile Deviation (Semi-interquartile range)**:** Definition, Coefficient of Quartile Deviation.

2.3 Mean Deviation (M.D.): Definition, Coefficient of M. D., Minimal property (without proof).

2.4 Mean Square Deviation (M.S.D.): Definition, Minimal property of M.S.D. (with proof)

2.5 Variance and Standard Deviation (S.D.): Definition, effect of change of origin and scale, combined variance for *n* groups (derivation for two groups). Illustrative examples.

2.6 Coefficient of Variation (C.V.): Definition and interpretation, Illustrative examples.

2.7 Moments: Raw moments and central moments for ungrouped and grouped data. Effect of change of origin and scale on central moments, relation between central moments and raw moments (up to 4th order). Sheppard's corrections.

2.8 Skewness: Concept of skewness of a frequency distribution, types of skewness. Bowley's coefficient of skewness, Karl Pearson's coefficient of skewness, measure of skewness based on moments.

2.9 Kurtosis: Concept of kurtosis of a frequency distribution, Types of kurtosis, Measure of kurtosis based on moments. Illustrative examples.

Reference Books:

1. Agarwal B. L. (2003). Programmed Statistics, Second Edition, New Age International Publisher, New Delhi.
2. Bhat B. R., Srivenkatramana T. and Rao Madhava, K. S. (1996). Statistics: A Beginner's Text: Vil. I, New Age International (P) Ltd.
3. Goon A. M., Gupta M.K. and Dasgupta B. (2002). Fundamentals of Statistics, Vol. I and II, 8th Edition, The World Press Pvt. Ltd. Kolkata.
4. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
5. Gupta V.K. and Kapoor S.C.: Fundamentals of Mathematical Statistics-Sultan & Chand.

DSC-1 (P)	**Practical**	**STATISTICS PRACTICAL-I**	**Credits: 02 Hours: 60**

Course Objectives:

1. Students will develop a strong foundation to analyze and interpret data in various fields.
2. Compute various measures of central tendency and dispersion.
3. Summarize data using frequency distributions and graphical representations.
4. Acquire proficiency in calculating and interpreting various quantiles.
5. Calculating and interpreting measures of central tendency (mean, median, mode) and dispersion (variance, standard deviation) for discrete random variables.

Course Outcomes:

At the end of this course students are expected to be able to

1. Understand the fundamental concepts of descriptive statistics, including measures of central tendency and measures of dispersion.
2. Utilize appropriate graphical representations and descriptive statistics measures to present and interpret data.
3. **A**pply knowledge and skills gained from the course to solve practical problems and make informed decisions.

List of Practical's

1	Diagrammatic and Graphical Representation-I (Line, Bar and Pie diagrams)
2	Diagrammatic and Graphical Representation-II (Histogram, Location of mode)
3	Diagrammatic and Graphical Representation-III (Frequency polygon, frequency curve)
4	Diagrammatic and Graphical Representation-IV (Ogive curves, Location of partition values)
5	Measures of Central Tendency - I (Ungrouped data)
6	Measures of Central Tendency -II (Grouped data)
7	Measures of the Dispersion -I (Ungrouped data)
8	Measures of the Dispersion -II (Grouped data)
9	Moments, Skewness and Kurtosis – I (Ungrouped data)
10	Moments, Skewness and Kurtosis – II (Grouped data)

OE-1	**Theory**	**FUNDAMENTALS OF STATISTICS**	**Credits: 02 Hours: 30**

Course Objectives:

1. To provide knowledge of data types, data collection techniques and data presentation.
2. To describe measures of central tendency and dispersion.
3. To discuss appropriate use of measures of central tendency and dispersion.

Course Outcomes:

After successful completion of this course, students are expected to:

1. Present the data diagrammatically and graphically.
2. Compute and interpret various measures of central tendency.
3. Summarize the information in the data using summary measures.
4. Compute and interpret various measures of dispersion.
5. Compute and interpret correlation coefficients.
6. Identify and model the relationship between two variables.

Course Content

Unit-1: **Classification and Measures of Central Tendency** **(15 hrs.)**

1.1 Types of Data: Meaning and scope of Statistics, concepts of a statistical population and sample from a population, qualitative and quantitative data, discrete and continuous data, Measurement scales - nominal, ordinal, ratio and interval scales.

1.2 Collection and Presentation of Data: Primary and Secondary data, Methods of collection for primary data, sources of secondary data. Classification of Individual data: ungrouped and grouped frequency distribution. Method of classification: inclusive and exclusive, open end classes, cumulative frequency distribution and relative frequency distribution.

1.3 Diagrammatic and graphical representation of data: Pie diagram, line diagram, Bar diagrams, histogram, frequency polygon, frequency curve and Ogive curves. Stem and leaf chart. Box plot.

1.4 Measures of Central Tendency: Concept of central tendency, Mathematical and positional averages, requirements of good average.

1.5 Mathematical averages: Arithmetic Mean (AM): Definition, Deviation of observations from A.M., Mean of pooled data, merits and demerits. **Geometric Mean (G.M.):** Definition, merits and demerits, uses of G.M. **Harmonic Mean (H.M.):** Definition, merits and demerits. Illustrative examples.

1.6 Positional Averages: Median: Definition, merits and demerits, **Mode:** Definition, merits and demerits, empirical relation between mean, median and mode (without proof). Determination of positional averages graphically. Illustrative examples.

Unit-2: Measures of Dispersion, Correlation and Regression (15 hrs.)

2.1 Measures of Dispersion: Concept of dispersion, Absolute and Relative Measures of dispersion, characteristics of good measures of dispersion.

2.2 Range and Quartile Deviation: Range: Definition, Coefficient of Range.
Quartile Deviation (Semi-interquartile range)**:** Definition, Coefficient of Quartile Deviation.

2.3 Mean Deviation (M.D.): Definition, Coefficient of M. D., **Mean Square Deviation (M.S.D.):** Definition.

2.4 Concept of Variance and Standard Deviation (S.D.), Illustrative examples.

2.5 Coefficient of Variation (C.V.): Definition and interpretation, Illustrative examples.

2.6 Correlation: Bivariate Data, Covariance: Definition, Concept of correlation between two variables, Types of correlation. Scatter diagram and its interpretation.

2.7 Karl Pearson's coefficient of correlation (r): Definition, Computation for ungrouped and grouped data, Properties: i) $-1 \le r \le 1$, (ii) Interpretation when $r = -1, 0, 1$. Illustrative examples.

2.8 Spearman's rank correlation coefficient (R): Definition, Computation (with and without ties). Illustrative examples.

2.9 Regression: Concept of dependent and independent variables. Concept of regression, Lines of regression. Identification of response and predictor variables and the relation between them. Illustrative Examples.

Reference Books:

1. Agarwal B. L. (2003). Programmed Statistics, Second Edition, New Age International Publisher, New Delhi.
2. Bhat B. R., Srivenkatramana T. and Rao Madhava, K. S. (1996). Statistics: A Beginner's Text: Vil. I, New Age International (P) Ltd.

3. Goon A. M., Gupta M.K. and Dasgupta B. (2002). Fundamentals of Statistics, Vol. I and II, 8th Edition, The World Press Pvt. Ltd. Kolkata.
4. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
5. Gupta V.K. and Kapoor S.C.: Fundamentals of Mathematical Statistics-Sultan & Chand.

SEC-1	Practical	DATA ANALYSIS USING MS-Excel-I	Credits: 02 Hours: 60

Course Objectives: The main objective of this course is to introduce the MS-Excel to the students. The course is aimed to inculcate analytical skills in students in order for them to fulfill current industry standards. At the end of the course, students are expected to be able,

1. To create a new worksheet in MS-Excel.
2. To edit data in MS-Excel.
3. To format data in MS-Excel.
4. To use inbuilt MS-Excel functions or formulae.

Course Outcomes:

At the end of the course, students are able to

1. Use MS-Excel in daily life.
2. Create spreadsheets, enter data, and maintain data in MS-Excel.
3. Handle data using existing MS-Excel functions.
4. Perform data analysis, generate summary statistics, and visualize data by using MS-Excel.
5. Present the available data graphically using MS-Excel.

Course Content

List of Practical's

1	Elementary MS-Excel-I
2	Elementary MS- Excel -II
3	Diagrammatic and Graphical Representation-I by using MS- Excel (Line, Bar and Pie diagrams)
4	Diagrammatic and Graphical Representation-II by using MS- Excel (Histogram, Location of mode)
5	Diagrammatic and Graphical Representation-III by using MS- Excel (Frequency polygon, frequency curve)
6	Diagrammatic and Graphical Representation-IV by using MS- Excel (Ogive curves, Location of partition values)
7	Computation of AM,GM,HM by using MS- Excel (Ungrouped data)
8	Computation of AM,GM,HM by using MS- Excel (Grouped data)
9	Computation of Median, Mode, Partition values by using MS- Excel (Ungrouped data)
10	Computation of Median, Mode, Partition values by using MS- Excel (Grouped data)

Reference Books:

1. Frag Curtis (2013). Step by Step Microsoft Excel 2013, MS Press.
2. Frye Curtis D. (2007). Step by step Microsoft Office Excel 2007, Microsoft Press.
3. John Walkenbach (2013). 101 Excel 2013 Tips, Tricks and Time severs, Wiley.
4. Kumar Bittu (2013). Microsoft Office 2010, V and S Publishers.
5. Salkind Neil J. and Frey Bruce B. (2021). Statistics for people who (Think They) Hate Statistics, Using MS- Excel, Sage Publications.
6. Sanjay Saxena (2007). MS Office 2000 for everyone, Vikas Publishing House.

B. Sc. Part-I (Statistics) Semester-II

DSC-2	Theory	ELEMENTARY STATISTICS	Credits: 02 Hours: 30

Course Objectives:

1. Understand the concept of sample spaces, events, independence of events.
2. Understand the concept of probability and its applications.
3. Differentiate between random and non-random experiment.
4. Compute probabilities of different events.
5. Solve the examples of probability.
6. Apply concept of correlation and regression.

Course Outcomes:

After successful completion of this course, students are expected to:

1. Understand the difference between random and nonrandom experiments.
2. Calculate probabilities and conditional probabilities.
3. Identify the types of events.
4. Apply the concept of probability in real-life situations.
5. Solve real life problems using correlation and regression.

Course Content

Unit-1: **Introduction to Probability** **(15 hrs.)**

1.1 Sample Space and Events: Concepts of experiments and random experiments. Definitions: Sample space, discrete sample space (finite and countably infinite), event, elementary event, compound event favorable event. Definitions of mutually exclusive events, exhaustive events, impossible events, certain event. Power set $P(\Omega)$ (sample space consisting at most 3 sample points). Illustrative examples.

1.2 Probability: Equally likely outcomes (events), apriori (classical) definition of probability of an event, axiomatic definition of probability with reference to a finite and countably infinite sample space.

1.3 Results (with proof):

i) $P(\Phi) = 0$

ii) $P(A^C) = 1 - P(A)$

iii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ and its generalization (Statement only).

iv) If $A \subset B$ then $P(A) \leq P(B)$

v) $0 \leq P(A \cap B) \leq \min\{P(A), P(B)\} \leq P(A \cup B) \leq [P(A) + P(B)]$

1.4 Conditional Probability: Definition of conditional probability of an event. Multiplication theorem for two events. Partition of sample space. Idea of Posteriori probability, Statement and proof of Baye's theorem. Examples and Problems.

1.5 Independence of Events: Concept of Independence of two events. Proof of the result that if A and B are independent then, A and B^c, ii) A^c and B, iii) A^c and B^c are independent. Pairwise and Mutual Independence for three events. Examples and Problems.

Unit-2: Correlation and Regression **(15 hrs.)**

2.1 Correlation: Bivariate Data, Covariance: Definition, Effect of change of origin and scale, Concept of correlation between two variables, Types of correlation. Scatter diagram and its interpretation.

2.2 Karl Pearson's coefficient of correlation (r): Definition, Computation for ungrouped and grouped data, Properties: i) $-1 \leq r \leq 1$, ii) Effect of change of origin and scale. (iii) Interpretation when $r = -1, 0, 1$. Illustrative examples.

2.3 Spearman's rank correlation coefficient (R): Definition, Computation (with and without ties). Derivation of the formula for without ties (In case of ties students are expected to compute Karl Pearson Correlation Coefficient), Illustrative examples.

2.4 Regression: Concept of dependent and independent variables. Concept of regression, Lines of regression. Identification of response and predictor variables and the relation between them. The difference between correlation and regression, Fitting of line $Y = a + bX$, where a and b are estimated using the least squares method.

2.5 Regression coefficients: Regression coefficients and their properties (with proof):

1) $b_{YX} \times b_{XY} = r^2$
2) $b_{YX} \times b_{XY} \leq 1$
3) $(b_{YX} + b_{XY})/2 \geq r$
4) Effect of change of origin and scale on regression coefficients.
5) The point of intersection of two regression lines.
6) Acute angle between two regression lines.

2.6 Illustrative Examples.

Reference Books:

1. Agarwal B. L. (2003). Programmed Statistics, 2nd edition, New Age International Publishers, New Delhi.
2. B.L.S. Prakas Rao, (2008). A First Course in Probability and Statistics, World Scientific Publishing Company.

3. Ross S. (2002). A First Course in Probability, 6th edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.
4. Walpole and Myres, (1986). Mathematical Statistics, 4th edition, Publisher: Longman Higher Education.
5. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, 8th Edition, Sultan Chand and Sons Publishers, New Delhi.
6. Lefebvre Mario (2006) Applied probability and Statistics, Publisher Springer
7. Mayer, P. (1972). Introductory Probability and Statistical Applications, Addison Wesley Publishing Co., London.
8. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John Wiley & Sons (Asia).
9. Hogg, R.V. and Craig R.G.(1989). Introduction to Mathematical Statistics, Ed. MacMillan Publishing Co., New York.

DSC-2 (P)	Practical	STATISTICS PRACTICAL-II	Credits: 02 Hours: 60

Course Outcomes:

At the end of this course students are expected to be able to

1. Utilize probability and discrete probability distributions to solve practical problems.
2. Utilize probability distributions to calculate probabilities of outcomes.
3. Apply critical thinking and problem-solving skills to real-world scenarios by effectively applying probability concepts.
4. **A**pply knowledge and skills gained from the course to solve practical problems and make informed decisions.
5. Apply concept of correlation to study dependence between variables.
6. Model the relationship between two correlated variables.

List of Practicals

1	Applications of Probability-I (Elementary Probability)
2	Applications of Probability-II (Conditional Probability)
3	Applications of Probability-III (Independence of Events)
4	Applications on Bayes' theorem
5	Scatter Diagram
6	Karl Pearson Correlation Coefficient (Ungrouped data)
7	Correlation Coefficient (Grouped data)
8	Spearman's Rank Correlation Coefficient
9	Regression – I (Ungrouped data)
10	Regression – II (Grouped data)

OE-2	Theory	SAMPLE SURVEY TECHNIQUES	Credits: 02

Course Objectives:

1. To understand the concept of population and sample.
2. To study different methods of sample selection.

Course Outcomes: The students will acquire knowledge of

1. Basic knowledge of complete enumeration and sample, sampling unit, sampling frame, types of surveys.
2. Understanding of principal steps in sample survey and methods of data collection.
3. Concept of various sampling methods such as SRS, stratified random sampling, systematic sampling and cluster sampling.
4. Conducting sample surveys and selecting appropriate sampling techniques.

Course Content

Unit 1: Introduction to Sampling (15 hrs.)

1.1 Population, sample, parameter, statistic, census or complete enumeration, sample, advantages of sampling over complete enumeration, sampling unit, sampling frame, designing a questionnaire, characteristics of a good questionnaire.

1.2 Types of surveys: Demographic surveys, Educational surveys, Economic surveys, Employment surveys, Health and nutrition surveys, Agricultural surveys, Marketing surveys, Election surveys, Public polls and surveys, and Campus surveys.

1.3 Principal steps in a sample survey: Objective of the survey, Population to be sampled, Data to be collected, Degree of precision required, Method of measurement, The frame, Selection of sample, The Pre-test, Organization of the fieldwork, Summary and analysis of data, . Information gained for future surveys.

1.4 Methods of data collection: Physical observations and measurements, Personal interviews, Mail enquiry, Web-based enquiry, Registration, Transcription from records. Concept of sampling and non-sampling errors. Introduction of probability and non-probability sampling.

Unit 2: Sampling Techniques (15 hrs.)

2.1 Simple Random Sampling (SRS): Definition, SRS with and without replacement. Procedure of SRS, Estimator of a population proportion, mean and total. Determination of sample size (formulae).

2.2 Stratified random sampling: Stratification, basis of stratification, real-life situation where stratification can be used. Procedure of stratified sampling, Estimator of a population proportion, mean and total. Problem of allocation: Equal allocation and Proportional allocation.

2.3 Systematic sampling: Real-life situations where systematic sampling is appropriate. Procedure of systematic sampling. Estimator of population proportion, mean and population total. Advantages of systematic sampling, The idea of circular systematic sampling.

2.4 Cluster sampling (equal size): Real-life situations where cluster sampling is appropriate. Construction of clusters. Estimator of population proportion, mean and total. Relation between systematic sampling, cluster sampling, and stratified sampling.

Reference Books:

1. Chaudhari, A. and Stenger, H. (2005). Survey sampling: theory and methods. CRC Press.
2. Cochran, W. G. (1977). Sampling techniques. John Wiley& Sons.
3. Gupta, S. C. and Kapoor, V. K. (2019). Fundamentals of applied statistics. Sulthan Chand & Sons.
4. Mukhopadhyay, P. (2008). Theory and methods of survey sampling. PHI Learning Pvt. Ltd..
5. Sukhatme, P.V. and Sukhatme, B.V. : Sampling Theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.
6. Thompson, S. K. (2012). Sampling (Vol. 755). John Wiley & Sons.
7. Wu, C. and Thompson, M. E. (2020). Sampling theory and practice. Cham: Springer International Publishing.

SEC-II	Practical	Data analysis using MS- Excel -II	Credits: 02 Hours: 60

Course Objectives: The main objective of this course is to introduce the MS-Excel to the students. The course is aimed to inculcate analytical skills in students in order for them to fulfill current industry standards. At the end of the course, students are expected to be able,

1. To create a new worksheet in MS-Excel.
2. To edit data in MS-Excel.
3. To format data in MS-Excel.
4. To use inbuilt MS-Excel functions or formulae.

Course Outcomes:

At the end of the course, students are able to

1. Obtain measures of dispersion using MS-Excel.
2. Study skewness and kurtosis of the data using MS-Excel.
3. Perform correlation analysis using MS-Excel functions.
4. Model linear relationship among the variables using regression technique.

Course Content

List of Practical's

1	Computation of Range, Quartile Deviation, Mean Deviation by using MS- Excel (Ungrouped data)
2	Computation of Range, Quartile Deviation, Mean Deviation by using MS- Excel (Grouped data)
3	Computation of Standard Deviation, Variance, Coefficient of Variation by using MS- Excel (Ungrouped data)
4	Computation of Standard Deviation, Variance, Coefficient of Variation by using MS- Excel (Grouped data)
5	Computation of Moments, Skewness and Kurtosis by using MS- Excel (Ungrouped data)
6	Computation of Moments, Skewness and Kurtosis by using MS- Excel (Grouped data)

7	Scatter Diagram by using MS- Excel
8	Computation of correlation coefficient by using MS- Excel
9	Computation of rank correlation coefficient by using MS- Excel
10	Computation of regression coefficient by using MS- Excel

Reference Books:

1. Frag Curtis (2013). Step by Step Microsoft Excel 2013, MS Press.
2. Frye Curtis D. (2007). Step by step Microsoft Office Excel 2007, Microsoft Press.
3. John Walkenbach (2013). 101 Excel 2013 Tips, Tricks and Time severs, Wiley.
4. Kumar Bittu (2013). Microsoft Office 2010, V and S Publishers.
5. Salkind Neil J. and Frey Bruce B. (2021). Statistics for people who (Think They) Hate Statistics, Using MS- Excel, Sage Publications.
6. Sanjay Saxena (2007). MS Office 2000 for everyone, Vikas Publishing House.

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