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| Programme/Class: Certificate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Year: First                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Semester: First (MINOR)   |
| Subject: STATISTICS (MINOR)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |
| Course Code: -B060102T                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Course Title:Descriptive Statistics (Univariate) and Theory of probability                                                                                                                                                                                                                                                                                                                                                                                            |                           |
| <p>Course outcomes:</p> <p>After completing this course a student will have:</p> <ul style="list-style-type: none"><li>✓Knowledge of Statistics, its scope and importance in various fields. ✓Ability to understand concepts of sample vs. population and difference between different types of data.</li><li>✓Knowledge of methods for summarising data sets, including common graphical tools (such as boxplots, histograms and stemplots). Interpret histograms and boxplots. ✓Ability to describe data with measures of central tendency and measures of dispersion.</li><li>✓Ability to understand measures of skewness and kurtosis and their utility and significance.</li><li>✓Ability to understand the concept of probability along with basic laws and axioms of probability.</li><li>✓Ability to understand the terms mutually exclusive and independence and their relevance.</li><li>✓Ability to identify the appropriate method (i.e. union, intersection, conditional, etc.) for solving a problem.</li></ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |
| Max. Marks: 25+75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Min. Passing Marks: ..... |
| Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | No. of Lectures           |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Introduction to Statistics, Meaning of Statistics, Importance of Statistics, Scope of Statistics in Industry, Introduction and contribution of Indian Scholars in Statistics. Concept of Statistical population, Attributes and Variables (Discrete and Continuous), Different types of scales – Nominal, Ordinal, Ratio and Interval, Primary data – designing a questionnaire and schedule, collection of primary data, checking their consistency, Secondary data. | 15                        |
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Presentation of data : Classification, Tabulation, Diagrammatic & Graphical Representation of Grouped data, Frequency distributions, Cumulative frequency distributions and their graphical representations, Histogram, Frequency polygon and Ogives. Stem and Leaf plot, Box Plot.                                                                                                                                                                                   | 15                        |
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Random experiment, Trial, Sample point and Sample space, Events, Operations of events, Concept of equally likely, Mutually exclusive and Exhaustive events. Definition of Probability: Classical, Relative frequency and Axiomatic approaches.                                                                                                                                                                                                                        | 15                        |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Discrete Probability Space, Properties of Probability under Set Theory Approach, Independence of Events, Conditional Probability, Total and Compound Probability theorems, Bayes theorem and its Applications.                                                                                                                                                                                                                                                        | 15                        |

### Suggested Readings:

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.
- Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10<sup>th</sup> ed.), Sultan Chand and Sons.
- Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.
- Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
- Mood, A.M. Graybill, F.A. and Boes, D.C. (2011). Introduction to the Theory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co. Ltd.
- David, S. (1994) : Elementary Probability, Cambridge University Press.
- Dudewicz, E.J. and Mishra, S.N. (2008). Modern Mathematics Statistics, Wiley.
- Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10<sup>th</sup> ed.), Sultan Chand and Sons.
- Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.
- Johnson, S. and Kotz, S. (1972). Distribution in Statistics Vol. I-II & III, Houghton and Mifflin.
- Lipschutz, S., Lipson, M. L. and Jain, K. (2010). Schaum's Outline of Probability. 2<sup>nd</sup> Edition. McGraw Hill Education Pvt. Ltd, New Delhi.
- Meyer, P. (2017). Introductory Probability and Statistical Applications (2<sup>nd</sup> ed.), New Delhi, Oxford & IBH Publishing Co. Pvt. Ltd.
- Mood A.M., Graybill F.A. and Boes D.C. (2007). Introduction to the Theory of Statistics (3<sup>rd</sup> ed.), New Delhi , Tata McGraw Hill Publishing Co. Ltd.
- Mukhopadhyay, P. (1996). Mathematical Statistics, New Delhi, New Central Book Agency Pvt. Ltd.
- Parzen, E.S. (1992). Modern Probability Theory and its Applications. Wiley Interscience.
- Pitman, J. (1993). Probability. Narosa Publishing House.
- Rao, C.R. (2009). Linear Statistical Inference and its Applications, 2<sup>nd</sup> Edition, Wiley Eastern.
- Rohatgi, V.K. and Saleh, A.E. (2008). An introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.

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| Programme/Class: Diploma                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Year: Second                                                                                                                                                                                                                                                                                                                                                                                      | Semester: Third (MINOR)   |
| Subject: STATISTICS (MINOR)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                   |                           |
| Course Code: -B060302T                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Course Title: Theory of Estimation and Sampling Survey                                                                                                                                                                                                                                                                                                                                            |                           |
| <p>Course outcomes:</p> <p>After completing this course a student will have:</p> <ul style="list-style-type: none"><li>✓Knowledge of the concept of Sampling distributions.</li><li>✓Ability to understand the difference between parameter &amp; statistic and standard error &amp; standard deviation.</li><li>✓Knowledge of the sampling distribution of the sum and mean.</li><li>✓Ability to understand the t, f and chi-square distribution and to identify the main characteristics of these distributions.</li><li>✓Knowledge of the concept of Point and Interval Estimation and discuss characteristics of a good estimator.</li><li>✓Ability to understand and practice various methods of estimations of parameters. ✓Ability to understand the concept of sampling and how it is different from complete enumeration.</li><li>✓Knowledge of various probability and non-probability sampling methods along with estimates of population parameters</li><li>✓Ability to identify the situations where the various sampling techniques shall be used. ✓Knowledge of sampling and non-sampling errors.</li><li>✓Knowledge of regression and ratio methods of estimation in simple random sampling.</li></ul> |                                                                                                                                                                                                                                                                                                                                                                                                   |                           |
| Max. Marks: 25+75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                   | Min. Passing Marks: ..... |
| Total No. of Lectures-Tutorials (in hours per week): 4-0-0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                   |                           |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Topic                                                                                                                                                                                                                                                                                                                                                                                             | No. of Lectures           |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Sampling Distributions: The concept of sampling distribution, Parameter, Statistic and Standard error. The sampling distribution for the sum of independent random variables of Binomial, Poisson and Normal distribution.                                                                                                                                                                        | 15                        |
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Central limit theorem, sampling distribution of Z. Sampling distribution of t, f, and chi-square without Central limit theorem, sampling distribution of derivations, Simple properties of these distributions $Z = [X - E(X)] / \text{standard deviation of } X$ and their interrelationship.                                                                                                    | 15                        |
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Sampling vs. Complete enumeration: Sampling units and Sampling frame, Precision and efficiency of estimators, Simple Random sampling with and without replacement, Use of random number tables in selection of simple random sample, Estimation of population mean and proportion, Derivation of expression for variance of these estimators, Estimation of variances, Sample size determination. | 15                        |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Stratified random sampling, Problem of allocation, proportional allocation, optimum allocation. Derivation of the expressions for the standard error of the usual estimators when these allocations are used, Gain in precision due to Stratification, Role of sampling cost in the sample allocation, Minimization of variance for fixed cost.                                                   | 15                        |

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| Programme/Class: Diploma                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Year: Second                                                                                                                                                                                                                                                                                                                                                                                      | Semester: Third (MINOR)   |
| Subject: STATISTICS (MINOR)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                   |                           |
| Course Code: -B060302T                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Course Title: Theory of Estimation and Sampling Survey                                                                                                                                                                                                                                                                                                                                            |                           |
| <b>Course outcomes:</b><br>After completing this course a student will have:<br>✓Knowledge of the concept of Sampling distributions.<br>✓Ability to understand the difference between parameter & statistic and standard error & standard deviation.<br>✓Knowledge of the sampling distribution of the sum and mean.<br>✓Ability to understand the t, f and chi-square distribution and to identify the main characteristics of these distributions.<br>✓Knowledge of the concept of Point and Interval Estimation and discuss characteristics of a good estimator.<br>✓Ability to understand and practice various methods of estimations of parameters. ✓Ability to understand the concept of sampling and how it is different from complete enumeration.<br>✓Knowledge of various probability and non-probability sampling methods along with estimates of population parameters<br>✓Ability to identify the situations where the various sampling techniques shall be used. ✓ Knowledge of sampling and non-sampling errors.<br>✓Knowledge of regression and ratio methods of estimation in simple random sampling. |                                                                                                                                                                                                                                                                                                                                                                                                   |                           |
| Max. Marks: 25+75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                   | Min. Passing Marks: ..... |
| Total No. of Lectures-Tutorials (in hours per week): 4-0-0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                   |                           |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Topic                                                                                                                                                                                                                                                                                                                                                                                             | No. of Lectures           |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Sampling Distributions: The concept of sampling distribution, Parameter, Statistic and Standard error. The sampling distribution for the sum of independent random variables of Binomial, Poisson and Normal distribution.                                                                                                                                                                        | 15                        |
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Central limit theorem, sampling distribution of Z. Sampling distribution of t, f, and chi-square without Central limit theorem, sampling distribution of derivations, Simple properties of these distributions $Z = [X - E(X)] / \text{standard deviation of } X$ and their interrelationship.                                                                                                    | 15                        |
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Sampling vs. Complete enumeration: Sampling units and Sampling frame, Precision and efficiency of estimators, Simple Random sampling with and without replacement, Use of random number tables in selection of simple random sample, Estimation of population mean and proportion, Derivation of expression for variance of these estimators, Estimation of variances, Sample size determination. | 15                        |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Stratified random sampling, Problem of allocation, proportional allocation, optimum allocation. Derivation of the expressions for the standard error of the usual estimators when these allocations are used, Gain in precision due to Stratification, Role of sampling cost in the sample allocation, Minimization of variance for fixed cost.                                                   | 15                        |

### Suggested Readings:

- Ferund J.E (2001) : Mathematical Statistics, Prentice Hall of India.
- Freedman, D., Pisani, R. and Purves, R. (2014). Statistics. 4<sup>th</sup> Edition. Norton & Comp.
- Goon, A.M., Gupta, M.K. & Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I., Kolkata, The World Press.
- Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10<sup>th</sup> ed.), Sultan Chand and Sons.
- Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.
- Hogg, R.V., McKean, J.W. & Craig, A.T. (2009). Introduction to Mathematical Statistics (6<sup>th</sup> ed.), Pearson.
- Kendall, M.G. and Stuart, A. (1979). The Advanced Theory of Statistics, Vol.2. Inference and Relationship. 4<sup>th</sup> Edition. Charles Griffin & Comp.
- Kendall, M.G., Stuart, A. and Ord, J.K. (1994). The Advanced Theory of Statistics, Vol. 1. Distribution Theory. 6<sup>th</sup> Edition. Halsted Press (Wiley Inc.).
- Kenney, J.F. and Keeping, E.S. (1947). Mathematics of Statistics. Part I. 2nd Edition. Chapman & Hall.
- Kenney, J.F. and Keeping, E.S. (1951). Mathematics of Statistics. Part II. 2nd Edition. Chapman & Hall.
- Mood A.M., Graybill F.A. and Boes D.C. (2007). Introduction to the Theory of Statistics (3<sup>rd</sup> ed.), New Delhi, Tata McGraw Hill Publishing Co. Ltd.
- Tanner, M. (1990). An Investigation for a Course in Statistics. McMillan, New York. Tanur, J.M. (1989) Statistics. A Guide to the Unknown. 3<sup>rd</sup> Edition, Duxbury Press.
- Yule, G.U. and Kendall, M.G. (1973). An Introduction to the Theory of Statistics. 14<sup>th</sup> Edition. Charles Griffin & Comp.
- Ardilly, P. and Yves T. (2006). Sampling Methods: Exercise and Solutions. Springer.
- Cochran, W.G. (2007). Sampling Techniques. (Third Edition). John Wiley & Sons, New Delhi.
- Cochran, W.G. (2008). Sampling Techniques (3<sup>rd</sup> ed.), Wiley India.
- Des Raj. (1976). Sampling Theory. Tata McGraw Hill, New York. (Reprint 1979). DesRaj and Chandhok, P. (1998). Sample Survey Theory, Narosa Publishing House.
- Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10<sup>th</sup> ed.), Sultan Chand and Sons.
- Mukhopadhyay, P. (2007). Survey Sampling. Narosa Publisher, New Delhi. Murthy, M. N. (1977). Sampling Theory and Statistical Methods. Statistical Pub. Society, Kolkata.
- Singh, D. and Choudhary, F.S. (1977). Theory and Analysis of Sample Survey Designs. Wiley Eastern Ltd, New Delhi. (Reprint 1986)
- Sukhatme, P.V. and Sukhatme, B.V. (1970). Sampling Theory Surveys with Applications (Second Edition). Iowa State University Press.
- Sukhatme, P.V., Sukhatme, B.V., Sukhatme, S. & Asok, C. (1984): Sampling Theories of Survey with Applications, IOWA State University Press and ISAS.
- Thompson, S.K. (2012). Sampling. John Wiley & Sons.