

Tribhuvan University  
**Institute of Science and Technology**  
Three year B. Sc./B.A. Statistics Course of Study  
2052

Statistics, which is mostly understood by a layman as a set of data has developed from its primitive form as a “Political Arithmetics” to present day’s most sophisticated scientific method for describing any phenomenon whether natural or man-made; making inferences on the causes and consequences of the phenomenon and making prediction and projections. Thus the study of Statistics has been “ a must” for the study of each and every academic discipline, The extent of the statistical knowledge to be imparted, however, varies according to the nature of the discipline. Accordingly, Statistics is taught in almost all subjects as integrated course.. On the other hand, statistics has also been developed as a separate discipline on its own by developing more and more new techniques and theories. Thus, Statistics is taught in academic circles as a vertical course and also as an integrated course to help other disciplines.

The present course is designed to meet the demands of both vertical and integrated Statistics courses.

A salient features of the course offered in three years B.Sc./B.A. Statistics is shown as:

Academic Year	Theory			Practical			Total Marks
	Course No.	Course Title	Marks	Course No.	Course Title	Marks	
I	Stat311	Descriptive Statistics & Introduction to Probability	100	Stat 312	Computational Statistics I	50	150

II	Stat321	Probability Theory & Statistical Method	100	Stat322	Computational Statistics II	50	150
III	Stat331	Design of Experiments & Sample Surveys	100	Stat333	Computational Statistics III	100	300
	Stat332	Applied Statistics	100				

Of above courses, courses offered at first year and second year are meant for both vertical and integrated programs in Statistics teaching, whereas courses offered at third year are exclusively for vertical program of Statistics teaching.

**Course Title:** Descriptive Statistics & Introduction to Probability      **Full Marks:** 100  
**Course No.:** STAT 311 (Major/Minor)      **Pass Marks:** 35  
**Nature of the Course:** Theory      **Year:** I

**Course Objectives:**

**General:**

- To develop and sustain interest among students in learning of Statistics and motivate them to apply statistics in their day to day life and enjoy the results.
- To promote awareness and understanding among the students the application of statistics in social, economic management and technical sciences.
- To show that statistics is the mathematical description of a phenomenon.

**Specific:**

- To introduce basic statistical ideas and methods so that the students may develop sense of appreciation for the subject.
- To introduce concepts of probability and its related theorems.
- To develop a base line knowledge for high level learning of statistics.

**Unit 1: Descriptive Statistics:**      Number of Periods: **75**

1.1 **Nature of Statistical Data:** Quantitative and qualitative data; Scales: Nominal, Ordinal, Interval and Ratio scales; Cross sectional and Time series data; Discrete and continuous data.

1.2 **Sources of Data:** Different sources of data: primary and secondary sources; Sources of primary data-

Censuses, Sample surveys and Observations; Sources of secondary data including official publications.

- 1.3 **Data Presentation:** Presentation of data by tables and diagrams according to one, two and three factors of classification; Presentation of data and tables by diagram: Frequency distribution for discrete and continuous data; Graphical presentation of frequency distribution by histogram, Frequency polygon and cumulative frequency distribution (inclusive and exclusive method) and gives.
- 1.4 **Fundamental Statistical Measures:** Concepts of moments, Moments of different orders, their relationships. Measures of central tendency; Dispersion, Skewness and Kurtosis for both grouped and ungrouped data; Use of Shepherd's correction and Charlier's checks for grouped data.
- 1.5 **Relation between tow Variables:** Scatterdiagram; Correlation; Spearman's rank correlation; Kendal Tau Ratio.
- 1.6 **Regression and Least Square Methods:** Principles of least square and fitting of 1<sup>st</sup> , 2<sup>nd</sup> and 3<sup>rd</sup> degree polynomials and exponential curves; Regression upto 3 variables; Error in regression and properties of residuals; Multiple and partial correlations upto 3 variables.
- 1.7 **Analysis of Categorical Data:** Fundamental set of frequencies; Consistency of data; Conditions for consistency; Independence and association of attributes; Various measures of association.

## **Unit 2: Introduction to Probability**

No. of Periods: **75**

- 2.1 **Events:** Fundamentals of set theory, random experiments, trials, definition of events, various types of events; set operation of events, sample point and sample space.
- 2.2 **Concepts of Probability:** Definition of probability- Classical and relative frequency; Richard Von Mises and Kolmogorov's approaches to probability; Merits and demerits of these approaches (only a general idea is to be given).
- 2.3 **Some Fundamental Theorems in Probability:** Additive and Multiplicative Laws of probability; Conditional probability extending to Bayes theorems; Geometric probability.
- 2.4 **Random Variable:** Definition of Random Variable (Discrete and Continuous); Expectation and related Theorems; Probability mass function (p.m.f.) & Probability density function (p.d.f.); Cumulative Distribution Function (c.d.f.); Measures of location, dispersion, moments, skewness and kurtosis for a given distribution; Concepts of Moment Generating Function (m.g.f.) and Probability Generating Function (p.g.f.).
- 2.5 **Univariate Distributions and their Properties:**
- Discrete:**  
Concepts, condition and derivation of distribution functions, moments and fundamental statistical measures; Properties and application of Univariate distribution such as Binomial, Poisson, Geometric, Hyper-geometric and Negative Binomial Distributions.

**Continuous:**

Concepts of Normal distribution; Derivation of its distribution function; Normal distribution as a limiting case of Binomial and Poisson distributions; Properties of Normal distribution; Concepts of uniform, Cauchy, Gamma, Beta distributions, Weibull distribution, Log-Normal distribution, their distribution functions, measures of their moments; their important properties and applications.

**Text Books:**

1. Yule G.V. and Kendall M.G., *An Introduction to the Theory of Statistics*, Charles Griffins & Co., London.
2. Shankarnarayan G., *Elementry Theory of Mathematical Statistics*, Oxford.

**Course Title:** Statistical Computation I  
**Course No.:** STAT 312 (Major/Minor)  
**Nature of the Course:** Practical

**Full Marks:** 50  
**Pass Marks:** 20  
**Year:** I

### **Course Objectives:**

#### **General:**

- To develop and sustain student's interest in computation Statistics and motivate them to enjoy its application.
- To develop among the students to skill of processing and interpreting data formulation and generalizations.

#### **Specific:**

- To impart training to students in Statistical Computation and to develop in them capabilities to apply Statistical theories in Practical Problems.
- To develop Statistical computational skills and knowledge in the areas prescribed in STAT 312

### **Unit 1: Computation of Statistical Measures:**

No. of Periods: **100**

#### **1.1 Computation of Elementary Statistical Measures:**

Construction of frequency tables and its graphical representation for continuous and discrete data; Computation of measures of central tendency from raw data; Computation of measures of central tendency from grouped data; Computation of measures of dispersion, skewness and kurtosis.

#### **1.2 Least Square Fittings:**

Least square fittings of polynomial upto 3 degree (2 problems); Least square fitting of exponential curve; construction of bivariate

frequency table for bivariate observations (2 problems-discrete & continuous).

- 1.3 **Computation of Regression & Correlation Coefficients:** Fitting of linear regression and computation of correlation coefficients from unclassified data; Fitting of linear regression and computation of correlation coefficients from data classified in a two way table; Fitting least square multiple regression for three variables.
- 1.4 **Computation of Multiple & Partial Correlation:** Computation of multiple and partial correlations for three variables.
- 1.5 **Fitting of Standard Distributions:** Fitting of Binomial, Poisson, Normal, Hypergeometric & Negative binomial distributions; Numerical problems based on Standard univariate distribution.
- 1.6 **Measures of Association:** Computation of measures of association.

**Unit 2: Computation of Probabilities:** No. of Periods: **60**

- 2.1 Numerical Exercise on Set operations
- 2.2 Numerical Exercise on Theory of Probability & related theorems
- 2.3 Numerical Exercise on Expectation & related theorems

**Course Title:** Probability Theory and  
Statistical Methods

**Full Marks:** 100

**Course No.:** STAT 321 (Major/Minor)

**Pass Marks:** 35

**Nature of the Course:** Theory

**Year:** II

**Course Objectives:**

**General:**

- To impart Statistical knowledge at a Intermediate level.
- To produce manpower in Statistics that can be geared towards the country's requirements at various levels of postings.
- To impart essential knowledge of Probability Theory and distributions.
- To give basic Statistical theories on parametric estimation, hypothesis testing and Non parametric testing.

**Unit 1: Probability Theory:**

No. of Periods: **75**

- 1.1 **Probability Distributions:** Truncated distributions (Binomial and Poisson).
- 1.2 **Bivariate Distributions:** Discrete & Continuous type; c.d.f., p.m.f., Marginal and conditional distributions; Independence of random variables. Function of one and two dimensional random variables; Jacobean of transformation; Distribution of sums, products and quotients of two random variables. Expectation and their properties; Conditional expectation (Simple case only).
- 1.3 **Some important theorems in Probability:** Chebyshev inequality and its applications; Concept of convergence

in probability; Weak law of large number; Central limit theorem (Statement and application only).

## **Unit 2: Statistical Methods:**

- 2.1 **Statistical Methods:** Sampling from a distribution: Definition of Random Sample; Statistics and its sampling distribution; Standard error of sample mean, sample proportion and sample moments; Sampling distribution of mean of random sample from Normal Population and sum of squares of standard normal deviates; Independence of sample mean and sample variance in random sampling from a Normal distribution (statement only).  $\chi^2$ , t, F distribution and their properties (Central distributions only).
- 2.2 **Theory of Estimation:** Point estimation for a Parameter; Requirements of a good estimator: unbiasedness, consistency, efficiency and sufficiency (definition only); Cramer Rao inequality; Maximum likelihood estimators and statement of their properties; Moment estimators; Construction of confidence interval estimator.
- 2.3 **Test of Significance:** Null and Alternative hypothesis; Type I and Type II errors; Level of significance; Critical value; Critical and acceptance region; Small sample test for the mean and variance of Univariate Normal Distribution; Testing of equality of two means and two variance of two Normal Distribution; Paired t-test, related confidence interval; Test of significance of simple correlation; Multiple and partial correlation; Test for linearity of regression. Large sample test and interval estimation of a mean and a proportion;

Difference of two means and two proportions; Fisher's Z-transformations and their uses; Chi-square test for (i) Goodness of fit (ii) homogeneity (iii) independence of attributes in a contingency table.

- 2.4 **Non-parametric test:** Definition of order Statistics upto 2<sup>nd</sup> order; Run test; Sing test; Wilcoxon Matched-pairs Signed Ranks Test; Mann-Whitney U-test; Median test; Kolmogorov-Smirnov test (one sample case); Cochran Q-test; Kruskal Wallis one way ANOVA test; Friedman two way ANOVA test.

**Text Books:**

1. Yule G.V. and Kendall M.G., *Elementary Theory of Mathematical Statistics*, Charles Griffins & Co., London.
2. Hogg R.V. and Tanis E.A., *Probability and Statistical Inference*, McMillan, New York.

**Course Title:** Statistical Computation II  
**Course No.:** STAT 322 (Major/Minor)  
**Nature of the Course:** Practical

**Full Marks:** 50  
**Pass Marks:** 20  
**Year:** II

### **Course Objectives:**

#### **General:**

- To provide knowledge and understanding of the principles and applications of computational statistics.
- To impart the skills pertaining to processing and interpretation data; formulation and generalization.

#### **Specific:**

- To impart training to students in Statistical computation involved in application of parametric and Non parametric tests.
- To develop capabilities to handle problems from various fields that need parametric confidence interval and application of Statistical hypothesis testing.

### **Unit 1: Fitting of Distributions and Statistical Tests:**

No. of Periods: **120**

- 1.1 **Fitting Standard Distributions:** Fitting Truncated Binomial distribution, Poisson distribution and Bivariate Normal distribution.
- 1.2 **Test of Means and Variance:** Test of single mean and single variance and their confidence intervals for large and small samples; Test of equality of two variances and confidence intervals for ratio of two variances; Test of difference between two means when variances are known or unknown for large and small samples; Test of

difference between two means when variances are known or unknown: related confidence intervals; Paired-test.

- 1.3 **Test of Correlation and Regression:** Test of significance of correlation coefficient and use of Z-transformation; Test of linearity of regression.
- 1.4 **Test of Proportions:** Test of significance for single and two proportions; Test of homogeneity of proportions.

**Unit 2: Non Parametric Test** No. of Periods: **40**

- 2.1 Numerical exercise related to non-parametric courses prescribed in Stat. 321.

**Course Title:** Sample Surveys and  
Design of Experiments

**Full Marks:** 100

**Course No.:** STAT 331 (Major)

**Pass Marks:** 35

**Nature of the Course:** Theory

**Year:** III

**Course Objectives:**

**General:**

- To introduce advanced techniques of data collection and analysis such as sample surveys and design of experiments.
- To produce manpower in Statistics that can be geared towards the country's requirements at various level of posting.

**Specific:**

- To provide basic concepts of sample surveys, Experimental Designs and also to provide basic knowledge of analysis of variance for one way and two way classified data.
- To give computational skills in analysis of designs such as CRD, RBD, LSD, Greco Latin square Design; Factorial designs such as  $2^2$ ,  $2^3$  and  $3^2$  designs and analysis of covariance.

**Unit 1: Design of Experiment:**

No. of Periods: **90**

- 1.1 **Analysis of Variance:** Concepts of linear model in ANOVA; Statement of Cochran theorem; Analysis of one way, two way classification (1 & m observations per cell) in fixed effect model.
- 1.2 **Simple Basic Designs:** Need for design of experiments; Fundamental principles of designs; CRD, RBD, LSD, Graeco Latin Square Designs and their analysis; Orthogonality of classification in two way layouts; Advantages of orthogonality relations; Simple

illustrations; Missing plot techniques for RBD and LSD (one observation missing only).

- 1.3 **Analysis of Covariance:** Analysis of Covariance for one way layout with one concomitant variable for CRBD.
- 1.4 **Factorial Designs:**  $2^2$ ,  $2^3$  and  $3^2$  designs; Main effects and interaction effects; Confounding in  $2^3$  factorial design.

**Unit 2: Sample Surveys:** No. of Periods: **60**

- 2.1 **Concepts of Sample Surveys:** Concepts of population and sample; Needs of sampling; Censuses and sample surveys; Basic concepts in sampling; Organizational aspects of sample surveys; Questionnaire design; Sample selection and sample size; Sampling and non sampling errors.
- 2.2 **Some Basic Sample Survey Methods:** Simple Random Sampling with and without replacement; Stratified random sampling. Ratio and regression methods of estimation under simple and stratified random sampling; PPS (with replacement): estimation of population total and its variance; Systematic Sampling.

**Text Books:**

1. Cochran W.G., *Sampling Techniques*, Wiley Eastern, New York.
2. Kempthorne O., *Design and Analysis of Experiments*, Wiley Eastern, New York.

**Course Title:** Applied Statistics  
**Course No.:** STAT 332 (Major)  
**Nature of the Course:** Theory

**Full Marks:** 100  
**Pass Marks:** 35  
**Year:** III

### **Course Objectives:**

#### **General:**

- To make the students aware of statistical techniques of applied nature usually used by economist, demographer, quality control engineers and applied scientists.

#### **Specific:**

- To impart to the students substantial knowledge of demographic measures and computing these measures.
- To enable them to handle basic tools used in Economic Statistics such as Index Numbers, Time Series, Quality Control and National Income as well as to give them the concepts of Nepalese Official Statistics.

### **Unit 1: Demography:**

No. of Periods: **75**

- 1.1 **Some Demographic Data:** Sources of demographic data: Census, Vital registration, Hospital records; Demographic sample surveys of Nepal with special reference to their objectives, methods and important results.
- 1.2 **Age Sex Composition:** Evaluation of Age and Sex data and Errors in age reporting; Whipple's index; UN's Age Sex accuracy Index; Population pyramid and age dependency ratio. Adjustment or smoothing of age distribution (methods of simple parabola only).

- 1.3 **Measurement of Mortality and Life Tables:** CDR; ASDR; Standardized death rates (direct, indirect methods); Comparative mortality index and life table death rate, complete life table- its functions and relation between its various functions; Abridged life tables and their construction by Reed-Merrell and Greville's methods.
- 1.4 **Measurement of Mortality and Life Tables:** CDR; ASDR; Standardized death rates direct, indirect and UN's Age Sex adjusted birth rate; Replacement index and intrinsic rate of population growth; Population growth; Population projection.
- 1.5 **Population Models:** Simple linear model; Compound interest model; Simple exponential model; Polynomial model upto third degree; Logistic models, use of these models in population projection; Population projection by component method.

## **Unit 2: Economic Statistics:**

- 2.1 **Index Number:** Index numbers- definitions and application of index numbers; Price relatives and quantity or volume relatives; Link and chain relatives; problems involved in computation of index numbers; Use of averages, simple and weighted aggregate methods; Laspeyrs Paasche, Fisher, Dorbish-Bowley and Marshall-Edgeworth Index number; Cost of living index number and its construction and real wages and their constructions.
- 2.2 **Time Series Analysis:** Economic time series- its different components; Additive and Multiplicative

models; Determination of trends; Moving average; Exponential smoothing; Analysis of seasonal fluctuation; Construction of seasonal indices; Forecasting by using time series methods.

- 2.3 **Statistical Quality Control:** Importance of statistical methods in industrial research and practice; Specification of items and lot qualities; Types of inspection; Determination of tolerance limits; General theory of control charts; Causes of variation in quality control limits; Sub grouping; Summary of out control criteria; Chart for attributes- NP chart, P-chart, C-chart, U-chart for variables- X and R charts.
- 2.4 **Nepalese Official Statistics:** Coverage, Sources & limitation of Official Statistics in Nepal related to Population, Agriculture, Labour and Industries.
- 2.5 **National Income:** Concepts of national income and its construction with special reference to Nepal.

**Books:**

1. Barday, *Demographic Techniques*, John Wiley and Sons, New York.
2. Singh M.L. and Saymi S.B., *Introduction to Mathematical Demography*, B.D. Manandhar, Kathmandu.
3. Goon A.M., Gupta M.K. and Dasgupta B., *Fundamentals of Statistics Vol. 2*, World Press, Calcutta, India.

**Course Title:** Statistical Computation III      **Full Marks:** 100  
**Course No.:** STAT 333 (Major)      **Pass Marks:** 40  
**Nature of the Course:** Practical      **Year:** III

**Course Objectives:**

**General:**

- To develop and sustain students in interesting statistical computation for problems of applied nature.
- To provide adequate knowledge and understanding of the principles and applications of statistical computation which contribute to the quality of life in a technologically based society.

**Specific:**

- To give students an understanding of advanced statistical techniques for applied fields.
- To train them in computer handling for statistical analysis.

**Unit 1: Statistical Computation Techniques in Experimental Design:**      No. of Periods: **60**

- 1.1 **Analysis of Variance:** One way analysis of variance; Two way analysis of variance.
- 1.2 **Various Design of Data Analysis:** Completely Randomized Design (CRD); Randomized Block Design (RBD); Latin Square Design (LSD); Creaco-Latin Square design (GLSD).
- 1.3 **Missing Plot Techniques and Analysis:** Missing plot in RBD with single covariate.

## **Unit 2: Statistical Techniques in Sample Surveys:**

No. of Periods: **60**

- 2.1 **Questionnaire Design and Sample Survey:** Questionnaire preparation for sample surveys; Use of random numbers in sample selection.
- 2.2 **Sampling:** Determination of sample size; Analysis of sample data using simple random sampling; Analysis of sample data using stratified sampling; analysis of sample data using systematic sampling. Ratio and regression method of estimation of population total; Estimation of population total and its variance in PPS sampling.

## **Unit 3: Demographic Techniques:**

No. of Periods: **80**

- 3.1 **Measure of Mortality & Fertility:** Computation of measures of age sex component; Computation of mortality measures; Computation of population replacement indices.

## **Unit 4: Economic Statistics:**

No. of Periods: **80**

- 4.1 **Index Number:** Construction of index numbers using different methods; Test of consistency of index number; Construction of cost of living index number; Computation of cost of real wage using index number.
- 4.2 **Determination of Trends:** Determination of trend by different methods; Computation of seasonal indices; Time series forecasts; Construction of X-chart; Construction of R-chart; Construction of P-chart; Construction of C-chart.

## **Unit 5: Application of Computer in Statistical Analysis:**

No. of Periods: 40

- 5.1 Basic Knowledge in Computer Operation.
- 5.2 Preparation of Table and Graphs.
- 5.3 Computation of Basic Statistical Measures by Using Computer. (Mean, Standard Deviation, Moments Correlation Coefficients and Regression Coefficients)
- 5.4 Concept of Computer Programming.
- 5.5 Model buildings and testing the models by different methods.

### **Text Books:**

1. Cochran W.G., *Sampling Techniques*, Wiley Eastern, New York.
2. Kempthorne O., *Design and Analysis of Experiment*, Wiley Eastern, New York.
3. Singh M.L. and Saymi S.B., *Introduction to Mathematical Demography*, B.D. Manandhar, Kathmandu.
4. Goon A.M., Gupta M.K. and Dasgupta B., *Fundamentals of Statistics Vol. 2*, World Press, Calcutta, India.

### **Reference: (For all Courses)**

1. Hole P.G., *An Introduction to Mathematical Statistics*, Asia Publishing House, New Delhi, India.
2. Wilks S.S., *Mathematical Statistics*, John Wiley & Sons, New York.
3. Des Raj, *Sampling Design*, Tata McGraw Hill, India.

4. Federe W.T., *Experimental Design*, Oxford and IBH, New Delhi.
5. Schaeffer L., Mendehall W., Loynen Ott, *Elementary Survey Sampling*, PWS KENT Pub.
6. Gnedenko B.V., *The Theory of Probability*, Mir Pub., Moscow.
7. Snedecor and Cochran W., *Statistical Method*, Iowa State University Press.
8. Anderson T.W., *An Introduction to Statistical Analysis of Data*, Houghton Mifflin & Co.
9. Chung K.L., *Elementary Probability Theory with Stochastic Processes*, Springer International Student Education.
10. Rohatgi V.K., *An Introduction to Probability Theory and Statistical Inference*, Wiley Eastern, New York.
11. Kenny S.F. & Keeping E.S., *Mathematical Statistics*, Vol. I, II, Van Nostrand.
12. Montgomery D.C., *Design and Analysis of Experiments*, John Wiley Co., New York.
13. Saigel S., *Non Parametric Statistics*, John Wiley Co., New York.
14. Mendemhall W., Weckaly D. and Schaeffer L., *Mathematical Statistics with Application*, Boston PWS Kent Publications, USA.
15. Myers R.H., *Classical and Modern Regression with Applications*, Boston Kent Publications, USA.
16. Bhat U., *Introduction to Stochastic Processes*, John Wiley Co., New York.
17. Mood A.M., Greville F.A. & Bose D.C., *Introduction to the Theory of Statistics*, McGraw Hill Publication, U.K.
18. Hogg R.V. and Craig A.T., *Introduction to Mathematical Statistics*, Collier McMillan Co., New York.
19. Singh M.L., *Understanding Research Methodology*, Kathmandu, Nepal.