Department of Statistics

H.N.B. Garhwal University, Srinagar Garhwal (Uttarakhand)
(A Central University)

Syllabus for UG (Statistics)
Frame work Program of 2 years (4 semesters)
(National Education Policy-2020)

Academic Session 2022-23
&
Onwards

Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
I	I	**STATT-101**	Univariate Descriptive Statistics and Probability	Theory	04
		STATP-102	Univariate Descriptive Data Analysis Lab	Practical	02
			Additional/ Interdisciplinary Subject		
		STATT-103	Statistical Methods and Probability Theory	Theory	02
		STATP-104	Statistical Methods and Probability Lab	Practical	02
			Skill Course		
		STATT-105	Differential Calculus	Theory	02
		STATT-106	**Extracurricular Courses** **(Understanding and Connecting with Environment)** **(University will prepare the course)**		02
	II	**STATT-107**	Bivariate Descriptive Statistics and Probability Distributions	Theory	04
		STATP-108	Bivariate Data Analysis Lab	Practical	02
			Additional/ Interdisciplinary Subject		
		STATT-109	Bivariate Statistical Methods and Probability Theory	Theory	02
		STATP-110	Bivariate Statistical Data Analysis Lab	Practical	02
			Skill Course		
		STATT-111	Algebra		02
		STATP-112	**Life Skills and Personality development** **(University will prepare the course)**		02
II	III	**STATT-113**	Theory of Estimation and Testing of Hypothesis	Theory	04
		STATP-114	Test of Significance Lab	Practical	02
			Additional/ Interdisciplinary Subject		

		STATT-115	Theory of Estimation	Theory	02
		STATP-116	Test of Implications Lab	Practical	02
		STATT-117	**Indian Knowledge System (IKS)**		02
	IV	**STATT-118**	Applied Statistics	Theory	04
		STATP-119	Applied Statistics Lab	Practical	02
			Additional/ Interdisciplinary Subject		
		STATT-120	Testing of Hypothesis	Theory	02
		STATP-121	Hypothesis Testing Lab	Practical	02
		STATT-122	**Indian Knowledge System (IKS)**	Theory	02

Subject Prerequisites

To study this subject a student must have the subject(s) Mathematics in class XII.

Program Outcomes (POs)

Students having Degree in B.Sc. (with Statistics) should have knowledge of different concepts and fundamentals of Statistics and ability to apply this knowledge in various fields of Government and Corporate Sectors. They may pursue their future career in the field of Statistical applications and Various Fundamental and Social Research.

Program Specific Outcomes (PSOs)

After completing B.Sc. (with Statistics) the student should have

- Knowledge of different concepts, principles, methodologies and tools (skills) of Statistics.
- Ability to collect, tabulates, represent graphically, analyze and interpret data/information by using appropriate statistical tools.
- Ability to identify and solve a wide range of problems in real life/industry related to Statistics.
- Familiarity with computational techniques and statistical software including programming language for mathematical and statistical computation.
- Capability to use appropriate statistical skills in interdisciplinary areas such as finance, health, agriculture, government, business, industry, telecommunication and bio-statistics.
- Ability to compete with industrial/private sector demand in the field of data analysis, marketing survey, etc. in professional manner and pursue their future career in the field of Statistics.
- Ability to develop original thinking for formulating new problems and providing their solutions.

As a result, they will be able to pursue higher studies or research in the field of Statistics.

Course outcomes:

After completing this course, a student will have:

- ✓ Knowledge of Statistics, its scope and importance in various fields.
- ✓ Ability to understand concepts of sample vs. population and difference between various types of data.
- ✓ Knowledge of methods for summarizing data sets, including common graphical tools (such as Boxplots, Histograms and Stem-Leaf-Plots). Interpret histograms and Boxplots.
- ✓ Ability to describe data with measures of central tendency and measures of dispersion.
- ✓ Ability to understand measures of skewness and kurtosis and their utility and significance.
- ✓ Ability to understand the concept of probability along with basic laws and axioms of probability.
- ✓ Ability to understand the terms mutually exclusive and independence and their relevance.
- ✓ Ability to identify the appropriate method (i.e., union, intersection, Complementation etc.) for solving a problem.
- ✓ Ability to apply basic probability principles to solve real life problems.

Program/Class: **Certificate**	Year: **First**	Semester: **First**
Subject: **STATISTICS**		
Course Code: **-STATT-101**	Course Title: **Univariate Descriptive Statistics and Probability**	
Credits: **04**	Core: **Compulsory**	
Part-A: Univariate Descriptive Statistics		
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.	
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, Boxplots.	
III	Measures of Central tendency and Dispersion and their properties, Merits and Demerits of these Measures.	

IV	Moments and Factorial moments, Sheppard's correction for moments, Measures of Skewness and Kurtosis and their significance, Measures based on quartiles.

Part-B: Probability	
V	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.
VI	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.
VII	Random Variables – Discrete and Continuous, Probability Mass Function (pmf) and Probability density function (pdf), Cumulative distribution function (cdf). Joint distribution of two random variables, Marginal and Conditional distributions, Independence of random variables.
VIII	Expectation of a random variable and its properties, Expectation of sum of random variables and product of independent random variables, Conditional expectation and related problems. Moments, Moment generating function (m.g.f.) & their properties, Continuity theorem for m.g.f. (without proof). Chebyshev's inequality, Weak law of large numbers for a sequence of independently and identically distributed random variables and their applications (without proof).

Suggested Readings:

Part A:

Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.

Goon, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamental of Statistics, Vol II, World Press, Kolkata.

Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th 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.andBoes,D.C.(2011).IntroductiontotheTheoryofStatistics,3rd Edn., Tata McGraw-Hill Pub. Co.Ltd.

Weatherburn, C.E. (1961). A First Course in Mathematical Statistics, The English Lang. Book Society and Cambridge Univ. Press.

Part B:

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 (10th ed.), Sultan Chand and Sons.

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Meyer,P.(2017). Introductory Probability and Statistical Applications (2nd 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 (3rd 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, 2nd Edition, Wiley Eastern.

Rohatgi, V.K. and Saleh, A.E. (2008). An introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.

Suggested Online Links/Readings:

http://heecontent.upsdc.gov.in/SearchContent.aspxhttps://swayam.gov.in/explorer?searchText=statisticshttps://nptel.ac.in/course.htmlhttps://www.edx.org/search?q=statistics https://www.coursera.org/search?query=statistics&

Course outcomes:

After completing this course, a student will have:

- ✓ Ability to represent/summarize the data/information using appropriate Graphical methods including common graphical tools (such as boxplots, histograms and stem and leaf plots) and also to draw inferences from these graphs
- ✓ Acquire the knowledge to identify the situation to apply appropriate measure of central tendency as per the nature and need of the data and draw meaningful conclusions regarding behavior of the data.
- ✓ Acquire the knowledge to identify the situation to apply appropriate measure of dispersion as per the nature and need of the data and draw meaningful conclusions regarding heterogeneity of the data.
- ✓ Ability to measure skewness and kurtosis of data and define their significance.
- ✓ Acquire the knowledge to compute conditional probabilities based on Bayes Theorem.

Programme/Class: **Certificate**	Year: **First**	Semester: **First**
Subject: **STATISTICS**		
Course Code: **-STATP-102**	**Course Title: Univariate Descriptive Data Analysis Lab**	
Credits: **02**	Core: **Compulsory**	

	List of Practical	
	1. Problems based on graphical representation of data by Histogram, Frequency polygons, frequency curves and Ogives, Stem and Leaf Plot, Boxplot. 2. Problems based on calculation of Measures of Central Tendency. 3. Problems based on calculation of Measures of Dispersion. 4. Problems based on calculation of Moments, Measures of Skewness and Kurtosis. 5. Computation of conditional probabilities based on Bayes theorem.	

Additional/ Interdisciplinary Subject

Course outcomes:

After completing this course, a student will have:

- ✓ 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.
- ✓ Knowledge of methods for summarizing data sets, including common graphical tools (such as boxplots, histograms and Stem and Leaf Plot). Interpret histograms and Boxplots.
- ✓ Ability to describe data with measures of central tendency and measures of dispersion.
- ✓ Ability to understand measures of skewness and kurtosis and their utility and significance.
- ✓ Ability to understand the concept of probability along with basic laws and axioms of probability.
- ✓ Ability to understand the terms mutually exclusive and independence and their relevance.
- ✓ Ability to identify the appropriate method (i.e., union, intersection, Complementation etc.) for solving a problem.
- ✓ Ability to apply basic probability principles to solve real life problems.

Program/Class: **Certificate**	Year: **First**	Semester: **First**
Subject: **STATISTICS**		
Course Code: **-STATT-103**	**Course Title**: **Statistical Methods and Probability Theory**	
Credits: **02**	Core: **Compulsory**	
Part-A: Statistical Methods		
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.	
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.	
III	Measures of Central tendency and Dispersion and their properties, Merits and Demerits of these Measures.	

Part B- Probability Theory	
IV	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.
V	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.
VI	Random Variables – Discrete and Continuous, Probability Mass Function (pmf) and Probability density function (pdf), Cumulative distribution function (cdf). Joint distribution of two random variables, Marginal and Conditional distributions, Independence of random variables.

Suggested Readings:

Part A:

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Mukhopadhyay, P. (1996). Mathematical Statistics, New Delhi, New Central Book Agency Pvt. Ltd.

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swayam.gov.in/explorer?searchText=statisticshttps://nptel
.ac.in/course.htmlhttps://www.edx.org/search?q=statistics
https://www.coursera.org/search?query=statistics&

Course outcomes:

After completing this course, a student will have:

- ✓ Ability to represent/summarize the data/information using appropriate Graphical methods including common graphical tools (such as boxplots, histograms and leaf stem plots) and also to draw inferences from these graphs.
- ✓ Acquire the knowledge to identify the situation to apply appropriate measure of central tendency as per the nature and need of the data and draw meaningful conclusions regarding behavior of the data.
- ✓ Acquire the knowledge to identify the situation to apply appropriate measure of dispersion as per the nature and need of the data and draw meaningful conclusions regarding heterogeneity of the data.

Program/Class: **Certificate**	Year: **First**	Semester: **First**
Subject: **STATISTICS**		
Course Code: -**STATP-104**	Course Title: **Statistical Methods and Probability Lab**	
Credits: **02**	Core: **Compulsory**	
	List of Practical	
	1. Problems based on graphical representation of data by Histogram, Frequency polygons, frequency curves and Ogives. 2. Problems based on calculation of Measures of Central Tendency. 3. Problems based on calculation of Measures of Dispersion.	

Course outcomes:

After completing this course, a student will have:

- ✓ Be able to explain the concept of differential equation.
- ✓ Classifies the differential equations with respect to their order and linearity.
- ✓ Explains the meaning of solution of a differential equation.
- ✓ Expresses the existence-uniqueness theorem of differential equations.
- ✓ Will be able to solve first-order ordinary differential equations.
- ✓ Solves exact differential equations.
- ✓ Converts separable and homogeneous equations to exact differential equations by integrating factors.
- ✓ Solves Bernoulli and Riccati differential equations.

Programme/Class: **Certificate**	Year: **First**	Semester: **First**
Subject: **STATISTICS**		
Course Code: -**STATT-105**	Course Title: Skill Enhancement Course: **Differential Calculus**	
Credits: **02**	Core: **Compulsory**	
Topic		
I	Limit, Continuity and Differentiability: Functions of one variable, Limit of a function (ε-δ), Continuity of a function, Properties of continuous functions, Intermediate value theorem, Classification of Discontinuities, Differentiability of a function, Rolle's Theorem.	
II	Mean value theorems and their geometrical interpretations, Applications of mean value theorems.	
III	Successive Differentiation, Expansions of functions and Indeterminate forms: Successive Differentiation, nth Differential coefficient of functions, Leibnitz Theorem, Taylor's Theorem, Maclaurin's Theorem, Taylor's and Maclaurin's series expansions.	

Suggested Readings:

1.M. Ray: Differential Calculus.
2. H. S. Dhami: Differential Calculus.
3. T. M. Apostol: Calculus.
4. S. Lang: A First Course in Calculus.
5. Gorakh Prasad: Differential Calculus

Extracurricular Courses

Programme/Class: **Certificate**	Year: **First**	Semester: **First**
Subject: **STATISTICS**		
Course Code: **-STATT-106**	Course Title: Understanding and Connecting with Environment	
Credits: **02**	Core: **Compulsory**	
The contents of this course shall be common as framed by the University.		

Course outcomes:

After completing this course, a student will have:

- ✓ Knowledge of the method of least squares for curve fitting to theoretically describe experimental data with a function or equation and to find the parameters associated with the model.
- ✓ Knowledge of the concepts of correlation and simple linear regression and Perform correlation and regression analysis.
- ✓ Ability to interpret results from correlation and regression.
- ✓ Ability to compute and interpret rank correlation.
- ✓ Ability to understand concept to qualitative data and its analysis.
- ✓ Knowledge of discrete distributions. Discuss appropriate distribution negative binomial, Poisson, etc. with their properties and application of discrete distribution models to solve problems.
- ✓ Knowledge of continuous distributions. Discuss the appropriate distribution (i.e. uniform, exponential, normal, etc.) with their properties and application of continuous distribution models to solve problems.
- ✓ Knowledge of the formal definition of order statistics, derive the distribution function and probability density function of the r^{th} order statistic and joint distribution of r^{th} and s^{th} order statistics.
- ✓ Ability to identify the application of theory of order statistics in real life problems.

Program/Class: **Certificate**	Year: **First**	Semester: **Second**
Subject: **STATISTICS**		
Course Code: - **STATT-107**	Course Title: **Bivariate Descriptive Statistics and Probability Distributions**	
Unit	Core: **Compulsory**	Credits: **04**
Part-A: Bivariate Descriptive Statistics		
I	Bivariate data, Principles of least squares, most plausible values, Meaning of curve fitting, Fitting of straight line, parabola, logarithmic, power curves and other simple forms by method of least squares.	
II	Bivariate frequency table, Correlation, Types of relationships, Scatter diagram, Karl-Pearson's Correlation Coefficient and its properties.	
III	Rank correlation and its coefficient (Spearman and Kendall Measures) Regression analysis through both types of regression equations for X and Y variables.	
IV	Attributes: Notion and Terminology, Contingency table, Class frequencies and Ultimate class frequencies, Consistency, Association of Attributes, Independence, Measures of association for 2X2 table, Chi-square, Karl Pearson's and Tschuprow's Coefficient of Association.	
Part-B: Probability Distributions		
V	Discrete Probability Distributions: Binomial distribution, Poisson distribution (as limiting case of Binomial distribution), Hypergeometric, Geometric and Negative Binomial, Uniform and Multinomial distributions, fitting of Binomial, Poisson and Uniform distributions.	
VI	Continuous Probability Distributions: Exponential, Gamma, Beta distributions. Cauchy, Laplace, Pareto, Weibull, Log normal distributions.	
VII	Normal distribution and its properties, Standard Normal variate, Normal distribution as limiting case of Binomial distribution, fitting of Normal distribution.	
VIII	Order Statistics, Distributions of minimum, r^{th} and maximum order statistic, Joint distribution of r^{th} and s^{th} order statistics (in continuous case), Distribution of sample range & sample median for uniform and exponential distributions.	

Suggested Readings:

Part A:

Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.

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Part B:

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David, H.A. (1981). Order Statistics (2nd ed.), New York, John Wiley.

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Course outcomes:

After completing this course, a student will have:

- ✓ Ability to deal with the problems based on fitting of curves by Method of least squares.
- ✓ E.g., fitting of straight-line, second-degree polynomial, power curve, exponential curve etc.
- ✓ Ability to deal with problems based on determination of Regression lines and calculation of Correlation coefficient–grouped and ungrouped data.
- ✓ Ability to deal with the problems based on determination of Rank correlation.
- ✓ Ability to fit binomial and Poisson distribution for given data.

Program/Class: **Certificate**	Year: **First**	Semester: **Second**
Subject: **STATISTICS**		
Course Code: - **STATP-108**	Course Title: **Bivariate Data Analysis Lab**	
Credits: **02**	Core: **Compulsory**	
	Topic	
	1. Problems based on fitting of curves by Method of least squares e.g. fitting of straight line, second degree polynomial, power curve, exponential curve etc. 2. Problems based on determination of Regression lines and calculation of Correlation coefficient – grouped and ungrouped data. 3. Problems based on determination of Rank correlation. 4. Fitting of Binomial, Poisson and Normal distribution.	

Additional/ Interdisciplinary Subject

Course outcomes:

After completing this course, a student will have:

- ✓ Knowledge of the concepts of correlation and simple linear regression and Perform correlation and regression analysis.
- ✓ Ability to interpret results from correlation and regression.
- ✓ Ability to compute and interpret rank correlation.
- ✓ Ability to understand concept of qualitative data and its analysis.
- ✓ Knowledge of discrete distributions. Discuss appropriate distribution negative binomial, Poisson, etc. with their properties and application of discrete distribution models to solve problems.
- ✓ Knowledge of continuous distributions. Discuss the appropriate distribution (i.e. uniform, exponential, normal, etc.) with their properties and application of continuous distribution models to solve problems.

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Programme/Class: **Certificate**	Year: **First**	Semester: **Second**
Subject: **STATISTICS**		
Course Code: - **STATT-109**	Course Title: **Bivariate Statistical Methods and Probability Theory**	
Unit	Core: **Compulsory**	Credits: **02**
Part-A: Bivariate Statistical Methods		
I	Bivariate data, Principles of least squares, most plausible values, Meaning of curve fitting, Fitting of straight line, parabola, logarithmic, power curves and other simple forms by method of least squares.	
II	Bi-Variate frequency table, Correlation, Types of relationships, Scatter diagram, Karl-Pearson's Correlation Coefficient and its properties.	
III	Rank correlation and its coefficient (Spearman and Kendall Measures) Regression analysis through both types of regression equations for X and Y variables.	
IV	Attributes: Notion and Terminology, Contingency table, Class frequencies and Ultimate class frequencies, Consistency, Association of Attributes, Independence, Measures of association for 2X2 table, Chi-square, Karl Pearson's and Tschuprow's Coefficient of Association.	
Part-B: Probability Theory		
V	Discrete Probability Distributions: Binomial distribution, Poisson distribution (as limiting case of Binomial distribution), Hypergeometric, Geometric and Negative Binomial, Uniform and Multinomial distributions, fitting of Binomial, Poisson and Uniform distributions.	
VI	Continuous Probability Distributions: Exponential, Gamma, Beta distributions. Cauchy, Laplace, Pareto, Weibull, Log normal distributions.	

Suggested Readings:

Part A:

Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.

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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, 2nd Edition, Wiley Eastern.

Rohatgi, V.K. and Saleh, A.E. (2008). An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.

Suggested Online Links/ Readings:

http://heecontent.upsdc.gov.in/SearchContent.aspxhttps://
swayam.gov.in/explorer?searchText=statisticshttps://nptel
.ac.in/course.htmlhttps://www.edx.org/search?q=statistics
https://www.coursera.org/search?query=statistics&

Course outcomes:

After completing this course, a student will have:

- ✓ Ability to deal with problems based on determination of Regression lines and
- ✓ Calculation of Correlation coefficient–grouped and ungrouped data.
- ✓ Ability to deal with the problems based on determination of Rank correlation.
- ✓ Ability to fit binomial and Poisson distribution for given data.

Programme/Class: **Certificate**	Year: **First**	Semester: **Second**
Subject: **STATISTICS**		
Course Code: - **STATP-110**	Course Title: **Bivariate Statistical Data Analysis Lab**	
Credits: **02**	Core: **Compulsory**	
	Topic	
	1. Problems based on fitting of curves by Method of least squares. 2. Problems based on determination of Regression lines and calculation of Correlation coefficient – grouped and ungrouped data. 3. Problems based on determination of Rank correlation.	

Course outcomes:

- ✓ Solve systems of linear equations
- ✓ Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and
- ✓ subspaces,
- ✓ Use matrix algebra and the related
- ✓ matrices to linear transformations,
- ✓ Compute and use determinants

Program/Class: **Certificate**	Year: **First**	Semester: **Second**
Subject: **STATISTICS**		
Course Code: -**STATT-111**	Course Title: **Skill Enhancement Course: Algebra**	
Credits: **02**	Core: **Compulsory**	

	Topic
I	Numbers: Natural numbers, Integers, Rational and Irrational numbers, Real numbers, Complex numbers, Mappings, Equivalence relation and partitions, Congruence modulo n.
II	Roots of equations: Fundamental Theorem of Algebra, Relations between Roots and Coefficients, transformation of equations, Descartes rule of signs, Algebraic Solution of a Cubic equations (Carden method), Bi-quadratic Equation.

Suggested Readings:

1. Leonard E. Dickson: First Course in the Theory of Equations.
2. Burnside, William Snow,Panton and Arthur William: The Theory of Equations, Volume I.
3. John Bird: Engineering Mathematics.
4. Rajendra Kumar Sharma, Sudesh Kumari Shah and Asha Gauri Shankar: Complex Numbers and the Theory of Equations.

Life skill and Personality development

Program /Class: **Certificate**	Year: **First**	Semester: **Second**
Subject: **STATISTICS**		
Course Code: - **STATT-112**	**Course Title: Life skill and Personality development**	
Credits: **02**	Core: **Compulsory**	

	The contents of this course shall be common as framed by the University.	

Course outcomes:

After completing this course, a student will have:

- ✓ Knowledge of the concept of Sampling distributions.
- ✓ Ability to understand the difference between parameter & statistic and standard error & standard deviation.
- ✓ Knowledge of the sampling distribution of the sum and mean.
- ✓ Ability to understand the t, f and chi-square distribution and to identify the main characteristics of these distributions.
- ✓ Knowledge of the concept of Point and Interval Estimation and discuss characteristics of a good estimator.
- ✓ Ability to understand and practice various methods of estimations of parameters.
- ✓ Knowledge of regression and ratio methods of estimation in simple random sampling (SRS).
- ✓ Knowledge of the terms like null and alternative hypotheses, two-tailed and one-tailed alternative hypotheses, significant and insignificant, level of significance and confidence, p value etc.
- ✓ Ability to understand the concept of MP, UMP and UMPU tests
- ✓ Ability to understand under what situations one would conduct the small sample and large sample tests (in case of one sample and two sample tests).
- ✓ Ability to understand the t, f and chi-square distribution and to identify the main characteristics of these distributions.

Programme/Class: **Diploma**	Year: **Second**	Semester: **Third**
Subject: **STATISTICS**		
Course Code: **-STATT-113**	Course Title: **Theory of Estimation and Testing of Hypothesis**	
Credits: **04**	Core: **Compulsory**	

Unit	Topic
	Part-A: Theory of Estimation
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.
II	Central limit theorem (without proof), sampling distribution of Z. Sampling distribution of t, f, and chi-square without derivations, Simple properties of these distributions and their interrelationship.
III	Point estimation: Characteristics of a good estimator: Unbiasedness, consistency, sufficiency and efficiency. Problems and examples, Interval estimation.
IV	Method of Maximum Likelihood and properties of maximum likelihood estimators (without proof), Method of minimum Chi-square. Method of least squares and methods of moments for estimation of parameters

Part-B: Testing of Hypothesis	
V	Statistical Hypothesis (Simple and Composite), Testing of hypothesis. Type–I and Type–II errors, Significance level, p-values
VI	Power of a test, Definitions of Most Powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests.
VII	Test of significance: large sample tests for (Attributes and Variables) proportions and means (i) for one sample (ii) for two samples Correlation coefficient in case of (a) $p=p_0$ (b) $p_1=p_2$.
VIII	Small sample test based on t, f and chi-square distributions.

Suggested Readings:

Part-A

Ferund J.E (2001) : Mathematical Statistics, Prentice Hall of India.

Freedman, D., Pisani, R. and Purves, R. (2014). Statistics. 4th Edition. Norton & Comp.

Goon, A.M., Gupta, M.K. & Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I. , Kolkata, The WorldPress.

Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.

Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. NewDelhi.

Hogg, R.V., McKean, J.W. & Craig, A.T. (2009). Introduction to Mathematical Statistics (6th ed.), Pearson.

Kendall, M.G. and Stuart, A. (1979). The Advanced Theory of Statistics, Vol.2. Inference and Relationship. 4th Edition. Charles Griffin & Comp.

Kendall, M.G., Stuart, A. and Ord, J.K. (1994). The Advanced Theory of Statistics, Vol. 1. Distribution Theory. 6th 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 (3rd 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. 3rd Edition, Duxbury Press.

Yule, G.U. and Kendall, M.G. (1973). An Introduction to the Theory of Statistics.14th Edition. Charles Griffin & Comp.

Part-B

Ferund J.E (2001) : Mathematical Statistics, Prentice Hall of India.

Freedman, D., Pisani, R. and Purves, R. (2014). Statistics. 4th Edition. Norton & Comp.

Goon, A.M., Gupta, M.K. & Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I. , Kolkata, The WorldPress.

Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.

Hangal, 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 (6th ed.), Pearson.

Kendall, M.G. and Stuart, A. (1979). The Advanced Theory of Statistics, Vol.2. Inference and Relationship. 4th Edition. Charles Griffin & Comp.

Kendall, M.G., Stuart, A. and Ord, J.K. (1994). The Advanced Theory of Statistics, Vol. 1. Distribution Theory. 6th 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..

Course outcomes:

After completing this course, a student will have:

- ✓ Ability to conduct test of significance based on t–test and Chi-square test.
- ✓ Knowledge about Fisher's Z-transformation and its use in testing
- ✓ Ability to deal with problems based on large sample tests.

Program/Class: **Diploma**	Year: **Second**	Semester: **Third**
Subject: **STATISTICS**		
Course Code: **-STATP-114**	Course Title: **Tests of Significance Lab**	
Credits: **02**	Core: **Compulsory**	
	Topic	
	1. Problems based on t –test. 2. Problems based on F-test. 3. Problems based on Chi-square test. 4. Problems based on Fisher's Z-transformation and its use in testing 5. Problems based on calculation of power curve. 6. Problems based on large sample tests.	

Additional/ Interdisciplinary Subject

Course outcomes:

After completing this course, a student will have:

- ✓Knowledge of the concept to Sampling distributions.
- ✓Ability to understand the difference between parameter & statistic and standard error & standard deviation.
- ✓Knowledge of the sampling distribution of the sum and mean.
- ✓Knowledge of the concept to Point and Interval Estimation and discuss characteristics of a good estimator.
- ✓Ability to understand and practice various methods of estimations of parameters.
- ✓Knowledge of regression and ratio methods of estimation in simple random sampling (SRS).

Program/Class: **Diploma**	Year: **Second**	Semester: **Third**
Subject: **STATISTICS**		
Course Code: - **STATT-115**	Course Title: **Theory of Estimation**	
Credits: **02**	Core: **Compulsory**	

Unit	Topic
	Theory of Estimation
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.
II	Central limit theorem (without proof), sampling distribution of Z. Sampling distribution of t, f, and chi-square without derivations, Simple properties of these distributions and their interrelationship.
III	Point estimation: Characteristics of a good estimator: Unbiasedness, consistency, sufficiency and efficiency. Problems and examples, Interval estimation.
IV	Method of Maximum Likelihood and properties of maximum likelihood estimators (without proof), Method of minimum Chi-square. Method of least squares and methods of moments for estimation of parameters.

Suggested Readings:

Ferund J.E (2001) : Mathematical Statistics, Prentice Hall of India.

Freedman, D., Pisani, R. and Purves, R. (2014). Statistics. 4th Edition. Norton & Comp.

Goon, A.M., Gupta, M.K. & Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I. , Kolkata, The WorldPress.

Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.

Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. NewDelhi.

Hogg, R.V., McKean, J.W. & Craig, A.T. (2009). Introduction to Mathematical Statistics (6th ed.), Pearson.

Kendall, M.G. and Stuart, A. (1979). The Advanced Theory of Statistics, Vol.2. Inference and Relationship. 4th Edition. Charles Griffin & Comp.

Kendall, M.G., Stuart, A. and Ord, J.K. (1994). The Advanced Theory of Statistics, Vol. 1. Distribution Theory. 6th 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 (3rd 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. 3rd Edition, Duxbury Press.

Yule, G.U. and Kendall, M.G. (1973). An Introduction to the Theory of Statistics.14th Edition. Charles Griffin & Comp.

Course outcomes:

After completing this course, a student will have:

- ✓ Ability to conduct test of significance based on t–test and Chi-square test.
- ✓ Knowledge about Fisher's Z-transformation and its use in testing
- ✓ Ability to deal with problems based on large sample tests.

Programme/Class: **Diploma**	Year: **Second**	Semester: **Third**
Subject: **STATISTICS**		
Course Code: **-STATP-116**	**Course Title**: **Tests of Implications Lab**	
Credits: **02**		Core: **Compulsory**

	Topic	
	1. Problems based on t –test. 2. Problems based on F-test. 3. Problems based on Chi-square test. 4. Problems based on Fisher's Z-transformation and its use in testing 5. Problems based on calculation of power curve. 6. Problems based on large sample tests.	

Indian Knowledge System (IKS)

Programme/Class: **Diploma**	Year: **Second**	Semester: **Third**
Subject: **STATISTICS**		
Course Code: - **STATT-117**	Course Title: Indian Knowledge System	
Credits: **02**	Core: **Compulsory**	

Unit	Topic	
	The contents of this course shall be common as framed by the University.	

Course outcomes:

After completing this course, a student will have:

- ✓ Familiarity with different aspects of Applied Statistics and their use in real life situations.
- ✓ Ability to understand the concept of Time series along with its different components.
- ✓ Knowledge of Index numbers and their applications along with different types of Index numbers.
- ✓ Familiarity with various demographic methods and different measures of mortality and fertility.
- ✓ Ability to understand the concept of life table and its construction.

Knowledge to understand the concept of statistical quality control and different control charts for variables and attributes.

Program /Class: **Diploma**	Year: **Second**	Semester: **Fourth**
Subject: **STATISTICS**		
Course Code: - **STATT-118**	Course Title: **Applied Statistics**	
Credits: **04**	Core: **Compulsory**	

Unit	Topic
	Applied Statistics
I	Introduction & Definition of Time Series, its different components, illustrations, additive and multiplicative models. Determination of trend by free hand curve, semi average method, moving average method, method of least squares, Analysis of Seasonal Component by Simple average method, Ratio to moving Average Ratio to Trend, Link relative method.
II	Index number – its definition, application of index number, price relative and quantity or volume relatives, link and chain relative, problem involved in computation of index number, use of averages, simple aggregative and weighted average method. Laspeyres, Paasche's and Fisher's index number, time and factor reversal tests of index numbers, consumer price index. Cost of Living Index Number.
III	Vital Statistics: Measurement of Fertility– Crude birth rate, general fertility rate, age-specific birth rate, total fertility rate, gross reproduction rate, net reproduction rate, standardized death rates. Complete life table, its main features and construction.
IV	Introduction to Statistical Quality Control, Process control, tools of statistical quality control, ± 3 Sigma control limits, Principle underlying the construction of control charts. Control charts for variables, 'X' and 'R' charts, construction and interpretation, Control charts for attributes 'p' and 'c' charts, construction and interpretation

Suggested Readings:

Croxton F.E., Cowden D.J. and Klein, S. (1973). Applied General Statistics (3rd ed.), Prentice Hall of India Pvt.Ltd.

Gupta, S.C. and Kapoor, V.K. (2008). Fundamentals of Applied Statistics (4th ed.), Sultan Chand and Sons.

Montgomery D.C. (2009) : Introduction to Statistical Quality Control (6th ed.), Wiley India Pvt. Ltd.

Mukhopadhyay, P (2011): Applied Statistics, 2nd edition revised reprint, Books and Allied (P) Ltd.

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Suggested Online Links/ Readings:

http://heecontent.upsdc.gov.in/SearchContent.aspxhttps://swayam.gov.in/explorer?searchText=statisticshttps://nptel.ac.in/course.htmlhttps://www.edx.org/search?q=statisticshttps://www.coursera.org/search?query=statistics&

Course outcomes:

After completing this course, a student will have:

- ✓ Ability to deal with problems based on time series and calculation of its different components for forecasting.
- ✓ Ability to deal with problems based on Index number.
- ✓ Acquire knowledge about measurement of mortality and fertility.
- ✓ Ability to deal with problems based on life table.
- ✓ Ability to work with control charts for variables and attributes and draw inferences.

Program/Class: **Diploma**	Year: **Second**	Semester: **Fourth**
Subject: **STATISTICS**		
Course Code: - **STATP-119**	Course Title: **Applied Statistics Lab**	
Credits: **02**	Core: **Compulsory**	

1. Problems based on time series and its different components
2. Problems based on Index number.
3. Problems based on measurement of mortality and fertility.
4. Problems based on logistic curve fitting.
5. Problems based on life table.
6. Problems based on control charts for variables and attributes.

Additional/ Interdisciplinary Subject

Course outcomes:

After completing this course, a student will have:

- ✓ Knowledge of the terms like null and alternative hypotheses, two-tailed and one-tailed alternative hypotheses, significant and insignificant, level of significance and confidence, p value etc.
- ✓ Ability to understand the concept of MP, UMP and UMPU tests
- ✓ Ability to understand under what situations one would conduct the small sample and large sample tests (in case of one sample and two sample tests).
- ✓ Ability to understand the t, f and chi-square distribution and to identify the main characteristics of these distributions.

Program/Class: **Diploma**	Year: **Second**	Semester: **Fourth**
Subject: **STATISTICS**		
Course Code: - **STATT-120**	Course Title: **Testing of Hypothesis**	
Credits: **02**	Core: **Compulsory**	

Unit	Topic
	Testing of Hypothesis
I	Statistical Hypothesis (Simple and Composite), Testing of hypothesis. Type–I and Type–II errors, Significance level, p-values
II	Power of a test, Definitions of Most Powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests.
III	Test of significance: large sample tests for (Attributes and Variables) proportions and means (i) for one sample (ii) for two samples Correlation coefficient in case of (a) $p=p_0$ (b) $p_1=p_2$.
IV	Small sample test based on t, f and chi-square distributions.

Suggested Readings:

Ferund J.E (2001) : Mathematical Statistics, Prentice Hall of India.

Freedman, D., Pisani, R. and Purves, R. (2014). Statistics. 4th Edition. Norton & Comp.

Goon, A.M., Gupta, M.K. & Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I. , Kolkata, The WorldPress.

Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.

Hangal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.

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Kendall, M.G., Stuart, A. and Ord, J.K. (1994). The Advanced Theory of Statistics, Vol. 1. Distribution Theory. 6th 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..

Course outcomes:

After completing this course, a student will have:

- ✓ Ability to conduct test of significance based on t–test and Chi-square test.
- ✓ Knowledge about Fisher's Z-transformation and its use in testing
- ✓ Ability to deal with problems based on large sample tests.

Programme/Class: **Diploma**	Year: **Second**	Semester**: Fourth**
Subject: **STATISTICS**		
Course Code: **-STATP-121**	Course Title: **Hypothesis Testing Lab**	
Credits: **02**	Core: **Compulsory**	
	Topic	
	1. Problems based on t –test. 2. Problems based on F-test. 3. Problems based on Chi-square test. 4. Problems based on Fisher's Z-transformation and its use in testing 5. Problems based on calculation of power curve. 6. Problems based on large sample tests.	

Indian Knowledge System (IKS)

Programme/Class: **Diploma**	Year: **Second**	Semester: **Fourth**
Subject: **STATISTICS**		
Course Code: - **STATT-122**	Course Title: Indian Knowledge System	
Credits: **02**	Core: **Compulsory**	
Unit	Topic	
	The contents of this course shall be common as framed by the University.	