

# UNIVERSITY OF KERALA



**Revised Scheme and Syllabus for Complementary Courses  
in Statistics for First Degree Programmes in Physics,  
Geography, Psychology and Economics  
Under CBCS System**

(with effect from 2017 admissions onwards)



FIRST DEGREE PROGRAMME UNDER CBCSS  
REVISED SCHEME AND SYLLABI FOR B.Sc. (Complementary) STATISTICS  
FOR PHYSICS CORE

The goal of the syllabus is that students understand statistics by using it effectively in real life situations. It is aimed that students have experience of the application of statistical methods to analyze data and get acquainted with situations where statistical thinking is helpful. Emphasis is given to practical-data collection and use of appropriate statistical tools to analyze them. There has to be lectures supported by problem sheets. There are practical sessions associated with each semester. Numerical problem solving using scientific calculators is also included in the ESE of Course I, II, III & IV. There is a component of one course in practical using Excel during Semester IV.

ESE of course I, II, III, & IV will be of 3 hours duration and have questions from all modules. Courses I & II will be of 2 credits each, III & IV will be of 3 credits each. The complementary course V viz., Practical using Excel in Semester IV will be of 2 hours duration of credit 4. Students are required to produce the fair record of practical done (module V of courses I, II, III and module IV of course IV) and print out of output of practical-course V of semester IV duly certified by the teacher concerned. Presenting the certified record is mandatory to appear for the practical examination. Complementary course V will be computer based, ESE will be held under the supervision of external examiners duly appointed by the University.

Sem	Title of the Course	Hrs/Week		No. of Credits	Total Hrs/Sem	ESE Duration	Evaluation weightage	
		L	P				CE	ESE
I	ST 1131.2 : Descriptive Statistics	2	2	2	72	3hrs	20%	80%
II	ST 1231.2 : Probability Theory	2	2	2	72	3hrs	20%	80%
III	ST 1331.2 : Probability Distributions and Stochastic Process	3	2	3	90	3hrs	20%	80%
IV	ST 1431.2 : Statistical Inference	3	2	3	90	3hrs	20%	80%
V	ST1432.2 : Practical using Excel			4		2hrs	20%	80%

**Complementary Course to First Degree Programme in Physics**  
**First Semester – Complementary Course 1**  
**ST: 1131.2 DESCRIPTIVE STATISTICS**

Hours per week: 4

Module I Concept of primary and secondary data, organization of a statistical survey, methods of collection of primary and secondary data, classification and tabulation of data, histogram, frequency curve, frequency polygon and ogive.



- Module II Central tendency and its measures-mean, median, mode, geometric mean, harmonic mean and combined mean. Dispersion and its measures- range, quartile deviation, mean deviation, standard deviation. Coefficient of variation and its use. Numerical problems covering these topics.
- Module III Raw moments, central moments and their inter-relationship, Sheppard's correction for moments for grouped data, skewness and its measures based on quartiles and moments, kurtosis and its moment measure. Numerical problems covering these topics.
- Module IV Concept of bivariate data, scatter diagram, curve fitting, principle of least squares. Fitting of curves of the forms:  $y = ax + b$ ,  $y = ax^2 + bx + c$ ,  $y = ae^{bx}$ ,  $y = ab^x$  and  $y = ax^b$ . Numerical problems covering these topics.
- Module V Linear correlation, Karl Pearson's coefficient of correlation, its invariance property, Spearman's rank correlation coefficient, tied ranks. Regression lines, its relation with correlation coefficient. Identifying regression lines, angle between regression lines. Numerical problems covering these topics.

#### References

1. Gupta, S. C. and Kapoor, V. K.: *Fundamentals of Mathematical Statistics*, Sultan Chand, New Delhi.
2. Martin B. R.: *Statistics for Physicists*, Academic Press, London.
3. A. M. Mathai and P. N Rathie: *Probability and Statistics*, MacMillan.
4. Goon, Gupta and Das Gupta: *Fundamentals of Statistics*, The World Press.
5. Elhance, D. N., Veena Elhance and B. M. Agarwal: *Fundamentals of Statistics*, Kitab Mahal Publications, Delhi.

## II Semester – Complementary Course 2

### ST 1231.2: Probability Theory

Module I

Hours/week: 4

Basic concepts in Probability, deterministic and random experiments, sample space, events, equally likely, mutually exclusive and exhaustive events. Definitions of probability – Mathematical, Statistical and Axiomatic. Definition of probability measure. Addition theorem (limited to 3 events). Numerical problems on these topics.



## Module II

Conditional probability and independence of events. Pairwise and mutual independence, multiplication theorem (limited to 3 events). Bayes' theorem and numerical problems on these topics.

## Module III

Definition of Random variable, Discrete and continuous random variables. Probability mass function, probability density function, distribution function, functions of random variables, change of variables (simple 1-1 functions only) and problems on these topics.

## Module IV

Bivariate distributions (Discrete and continuous), joint, marginal and conditional distributions, independence of two random variables and problems on these topics.

## Module V

Mathematical expectation, definition and elementary properties, mean deviation from mean, moments, moment generating function and its properties, characteristic function and its properties, definition and simple properties of conditional mean and conditional variance and problems on these topics.

## References:

1. Gupta, S.C. & Kapoor V.K.: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
2. Mathai A.M. & Rathie N. : Probability and Statistics, Macmillan.
3. Goon, Gupta & Das Gupta: Fundamentals of Statistics, the world press.
4. Martin B.R. : Statistics for Physicists, Academic Press, London.

### III Semester-Complementary Course 3

#### ST 1331.2 : Probability Distributions and Stochastic Process

Hours/week-5

#### Module I:

Standard Discrete Distributions: Uniform, Binomial, Poisson, Geometric and Negative Binomial distributions and their properties. Fitting of binomial and Poisson distributions.

#### Module II:

Standard Continuous Distributions: Rectangular, Beta, Gamma, Exponential, Normal and Weibull distributions and their properties. Fitting of Normal Distribution. Characterisation of Normal Distribution by the property of entropy.



**Module III:**

Concept of random sample, statistic, parameter, standard error, sampling distribution. Sampling distribution of mean of samples taken from a normal population. Sampling distribution of variance of samples taken from a normal population, chi-square, Student's t and F distributions (derivations of pdf not required), their Inter-relationship, examples of statistics following these distributions. Central limit theorem (Statement only).

**Module IV:**

Elements of Combinatorial Analysis: Definition of pairs and multiplsets, ordered samples, sub populations and partitions, Maxwell-Boltzmann statistics, Bose-Einstein statistics and Fermi-Dirac statistics.

**Module V:**

Stochastic Process: Introduction to Stochastic process, time and state space, classification of Stochastic processes, process with stationary independent increments (definition only). Basic concepts and examples of Markov Process, Markov Chain, transition probability matrix, initial probability vector. Definitions of random walk and Brownian Motion.

**References:**

1. Biswal P.C., *Probability and Statistics* (Prentice Hall of India)
2. Feller W., *An introduction to probability Theory and its Applications* Chapter -2, Vol.1(Wiley Eastern Limited, New Delhi)
3. Gupta S.C and Kapoor V.K., *Fundamentals of Mathematical Statistics* (Sultan Chand and Co. New Delhi)
4. Mathai A.M and Rathe.P.N., *Probability and Statistics* (Macmillan company of India, New Delhi)
5. Medhi.J., *Stochastic Processes* (New age international (P) limited)
6. Nabendu Pal and Sahadeb Sarkar.. *Statistics Concepts and Applications* (Prentice Hall of India)

**IV Semester: Complementary Course 4****ST1431.2. Statistical Inference**

- Module I: Point Estimation- Concept, Desirable properties of a good estimator, Statement of Fisher- Neyman Factorization Theorem and applications, Methods of Estimation- Maximum Likelihood estimator and moment estimators
- Module II: Interval Estimation-Concept, Interval estimators of mean, variance and proportion Interval estimators of differences of means, variances and proportions
- Module III: Basic Concepts of testing Hypotheses, Statement of Neyman -Pearson Lemma and its use, Large Sample Tests concerning mean, equality of means, proportion and equality of proportions. Test based on based on chi-square distribution for goodness of fit and for independent of attributes



Module IV: Small Sample tests: Testing the hypotheses of mean and equality of means for Normal population, paired t- test, Testing the hypotheses of variance and equality of variances for Normal population.

Module V: One-way and Two – way Analysis of variance (with one observation per cell): Assumptions, data layout, model specification, hypothesis, and various sum of squares (without any derivations). ANOVA table and conclusions. Numerical problems.

### References:

1. Biswal P.C : Probability and Statistics (PHI)
2. Gupta S V and Kapoor V K : Fundamentals of Mathematical Statistics (Sultan Chand And Co, New Delhi)
3. Gupta S V and Kapoor V K : Applied Statistics, (Sultan Chand And Co, New Delhi)
4. Mathai A N and Rathe P N : Probability and Statistics (Mc Millan Company of India, New Delhi)
5. Nabenda Pal and Sahadeb Sarkar : Statistics Concepts and Applications (PHI)

### Fourth Semester: Complementary Course -5, ST 1432.2 Practical

This shall cover numerical problems based on ST 1131.2, ST 1231.2, ST 1331.2 and ST 1431.2. The problems need to be solved by using Microsoft Excel. The course content for practical shall be divided into 3 sections – Charts, Functions and Data analysis.

#### Section 1 – Charts

This section shall cover three charts namely Column, Pie and Scatter. These are available in “Insert” menu in the Excel worksheet.

#### Section 2 - Functions

The use of following functions for evaluating numerical problems shall be covered from the four theory courses and they can be accessed from “Insert Function” bar in Excel worksheet.

- |                 |             |              |             |               |             |
|-----------------|-------------|--------------|-------------|---------------|-------------|
| 1. AVEDEV       | 2. AVERAGE  | 3. BINOMDIST | 4. CHIDIST  | 5. CHIINV     | 6. CHITEST  |
| 7. CONFIDENCE   | 8. CORREL   | 9. COVAR     | 10. DEVSQ   | 11. FDIST     | 12. FINV    |
| 13. FREQUENCY   | 14. FTEST   | 15. GEOMEAN  | 16. HARMEAN | 17. INTERCEPT | 18. KURT    |
| 19. MEDIAN      | 20. MODE    | 21. LINEST   | 22. LOGEST  | 23. NORMDIST  | 24. NORMINV |
| 25. NORMSDIST   | 26. PEARSON | 27. POISSON  | 28. PROB    | 29. SKEW      | 30. SLOPE   |
| 31. STANDARDIZE | 32. STDEVP  | 33. TDIST    | 34. TINV    | 35. TREND     | 36. TTEST   |

#### Section 3 – Data analysis

This section shall include usage of following functions available in Data analysis pack, which can be accessed from Data in the main menu.

- |              |                           |               |                |
|--------------|---------------------------|---------------|----------------|
| 1. Histogram | 2. Descriptive statistics | 3. Covariance | 4. Correlation |
|--------------|---------------------------|---------------|----------------|



- |                                                                           |                                                                                                                       |             |                                                   |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------|
| 5. Regression<br>two sample for mean<br>sample for means<br>single factor | 6. Random number generation<br>9. t-test Two sampling assuming equal variances<br>11. F-test Two sample for variances | 7. Sampling | 8. t-test Paired<br>10. z-test Two<br>11. Anova - |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------|
12. Anova – Two factor without replication.

### References

1. Dan Remenyi, George Onofrei, Joe English (2010). *An introduction to Statistics using Microsoft Excel*, Academic Publishing Ltd, UK.
2. Neil J Salkind (2010). *Excel Statistics – A quick guide*, Sage Publishers, New Delhi.
3. Vijai Gupta (2002). *Statistical analysis with Excel*, VJ Books Inc. Canada.
4. [www.excelfunctions.net](http://www.excelfunctions.net)

### Practical Record

The practical record shall contain at least one question illustrating each chart and function detailed above. The answer to each question shall include the procedure of solution, its excel function, the answer obtained along with the interpretation, if any, and its printout wherever it seems possible. For example for finding the median of a raw data, the procedure shall be given along with the required Excel function viz., MEDIAN but attaching a printout of solution is needless, whereas for a testing problem like ANOVA, the printout of the result can be included along with the interpretation.

The record may be divided into three sections as above and the practical sheets in each section shall be as given below:

#### Section 1: Charts

Sheet No.1 Column chart, Pie diagram and Scatter diagram.

#### Section 2: Functions

Sheet No. 2 Central tendency and Dispersion.

Sheet No. 3 Moments, Skewness and Kurtosis.

Sheet No. 4 Probability.

Sheet No. 5 Statistical distributions.

Sheet No. 6 Fitting of curves.

Sheet No. 7 Correlation and Regression.

#### Section 3: Data Analysis

Sheet No. 8 t-tests.

Sheet No. 9 Z-tests.

Sheet No. 10 F-test and ANOVA.



## FIRST DEGREE PROGRAMME UNDER CBCSS

## REVISED SCHEME AND SYLLABI FOR B.Sc. (Complementary) STATISTICS

## FOR PSYCHOLOGY CORE

The goal of the syllabus is that students understand statistics by using it effectively in real life situations. It is aimed that students have experience of the application of statistical methods to analyze data and get acquainted with situations where statistical thinking is helpful. Emphasis is given to practical-data collection and use of appropriate statistical tools to analyze them. There has to be lectures supported by problem sheets. Numerical problem solving using scientific calculators is also included in the ESE of Course I, II, III & IV. ESE of course I, II, III, & IV will be of 3 hours duration and have questions from all modules. Courses I & II will be of 2 credits each, III & IV will be of 3 credits each.

Sem	Title of the Course	Hrs/Week	No. of Credits	Total Hrs/Sem	ESE Duration	Evaluation weightage	
						CE	ESE
I	ST 1131.5 : Statistical Methods for Psychology I	3	2	54	3hrs	20%	80%
II	ST 1231.5 : Statistical Methods for Psychology II	3	2	54	3hrs	20%	80%
III	ST 1331.5 : Statistical Methods for Psychology III	3	3	54	3hrs	20%	80%
IV	ST 1431.5 : Statistical Methods for Psychology IV	3	3	54	3hrs	20%	80%

Complementary Course to First Degree Programmer for Psychology  
I Semester- Complementary Course 1

## ST 1131.5 : STATISTICAL METHODS FOR PSYCHOLOGY I

Credits:2

Weekly Hours :3

**Module 1**

Meaning of Statistics, Functions of Statistics, Need and Importance of Statistics in Psychology.  
Limitations of Statistics

Prerequisites for studying Statistics-Essential Mathematical fundamentals-solving linear equations,  
Theory of indices, Ratios.

Types of variables employed in measurements – discrete and continuous variable, quantitative variables.  
scale of measurement Nominal scale, Ordinal scale, Interval scale, Ratio scale with suitable examples from Psychological data.



**Module**

Collection of Data: Primary data and secondary data, Choice between primary and secondary data. Methods of collecting primary data, merits and demerits of different methods of collecting primary data, Sources of secondary data, Precaution in the use of secondary data. Testing reliability, validity and objectivity of questionnaire.

**Module III**

Census and sampling method. Methods of sampling –Random sampling and Non-random sampling, Stratified sampling, systematic sampling, Multi stage sampling, Cluster sampling. Selection of appropriate sampling method, Merits and demerits of different sampling methods.

**Module IV**

Classification and Tabulation: Meaning and objective of classification , Type of classification- geographical classification, Chronological classification, quantitative classification .

Tabulation of data, Formation of discrete and continuous frequency distribution. Class limits, class boundaries , class mark , raw data , ungrouped and grouped data. Cumulative frequency distribution , cumulative percentage frequency distribution

**Module V**

Diagrammatic Representations-Bar diagrams , types of Bar diagrams, Pie diagram, Pictograms and cartograms.

Graphical representations: Histogram, Frequency polygon, frequency curve, Ogives.

**References**

1. Garret E. Henry (2004). Statistics in psychology and education (11th ed): Paragon International publishers New Delhi.
2. Gravetter, F. J & Wallnau, L.B (2000). Statistics for Behavioral Science (5th ed.) Wadsworth-Thomson learning Singapore .
3. Aron, A, Aron. R, & Coups E. J. (2006). Statistics for psychology (4th ed.): Pearson Education , New Delhi.
4. Heiman W. Carry (2000). Basic statistics for behavioral science (3rd ed.), Houghton Mifflin Company ,New York.
5. Mangal ,S.k. (2000). Statistics in Psychology and Education.(2nd ed.): Prentice –Hall of India Private Limited, New Delhi.
6. Minium W. Edward, King M. Bruce & Bear Gordon (2001). Statistical Reasoning in Psychology and Education (3rd ed.), John Wiley & Sons, Inc., New York
7. Yule Undy G. & Kendal M.G. (1991). An Introduction To Theory of Statistics.(14th ed.), Universal Book Stall, New Delhi



COMPLEMENTARY COURSE TO FIRST DEGREE PROGRAMME FOR PSYCHOLOGY

II SEMESTER- COMPLEMENTARY COURSE II

ST1231.5: STATISTICAL METHODS FOR PSYCHOLOGY II

Credit: 2

Weekly hours: 3

**Module I**

Meaning and importance of Measures of Central tendency, Properties of a good average, simple arithmetic mean and weighted arithmetic mean, Computation of arithmetic mean for raw, ungrouped and grouped data. Computation of Median from raw, ungrouped and grouped data. Computation of Mode from raw, ungrouped and grouped data. Graphical determination of median and mode, when to use mean, median and mode.

**Module II**

Percentiles, Quartiles and deciles. Computation of Percentiles, Quartiles and deciles. Percentile rank: definition, computation and utility of percentile and percentile rank.

**Module III**

Meaning and importance the Measures of Variability, Properties of a good measure of variability, Range, Mean Deviation, Quartile Deviation, Standard Deviation: Computation and use. Comparison of different measures of variability. Relative measures of variation- coefficient of range, coefficient of quartile deviation, coefficient of variation, computation and use, when to use various measures of variability.

**Module IV**

Skewness- definition, measures of skewness- Karl Pearson's coefficient of skewness, Bowley's coefficient of skewness. Kurtosis, Measures of Kurtosis. Simple numerical problems for raw data only. (Moment measures of skewness and kurtosis are not required)

**Module V**

Basic concepts of set theory, set operations. Probability-Random experiment, sample space, event, different types of events. Classical and frequency definition of probability. Addition theorem, independence of events, simple problems.

**References**

1. Garret E. Henry (2004). Statistics in psychology and education (11th ed): Paragon International publishers New Delhi.



2. Gravetter, F. J. & Wallnau, L. B. (2000). *Statistics for Behavioral Science* (5th ed.) Wadsworth-Thomson Learning, Singapore.
3. Aron, A., Aron, R., & Coups, E. J. (2006). *Statistics for psychology* (4th ed.): Pearson Education, New Delhi.
4. Heiman, W. G. (2000). *Basic statistics for behavioral science* (3rd ed.), Houghton Mifflin Company, New York.
5. Mangal, S. K. (2000). *Statistics in Psychology and Education*. (2nd ed.): Prentice-Hall of India Private Limited, New Delhi.
6. Minium, W. Edward, King, M. Bruce & Bear, Gordon (2001). *Statistical Reasoning in Psychology and Education* (3rd ed.), John Wiley & Sons, Inc., New York.
7. Yule, G. U. & Kendall, M. G. (1991). *An Introduction to the Theory of Statistics*. (14th ed.), Universal Book Stall, New Delhi.

Complementary Course to First Degree Programme for Psychology  
III Semester – Complementary Course VI

ST 1331.5: STATISTICAL METHODS FOR PSYCHOLOGY III

Credits: 3

Weekly hours : 3

Module I

Correlation Analysis-Significance of the study of correlation, Types of correlation- Linear, Non linear correlation, Direct and inverse. Methods of studying correlation: Scatter diagram method, Karl Pearson's coefficient of correlation, Properties of coefficient of correlation, Spearman's rank correlation coefficient (No derivations). Numerical problems

Module II

Significance of the study of regression, difference between correlation and regression analysis. Regression equations- Regression equation of Y on X, Regression equation of X on Y. Regression coefficients, Properties of regression coefficients, Relation between correlation coefficient and regression coefficients. Regression and prediction.

Module III

Difference between Correlation and Association, Consistency of data, Association and Disassociation, Methods of studying Association: Yule's coefficient of association, Coefficient of colligation. Simple numerical problems.

Module IV

Random variable, Discrete and continuous random variable, Probability mass function, probability density function, Probability Distributions- Basic concepts, definitions and properties. Problems on discrete random variables.



Standard distributions: Binomial, Poisson- definition, Derivation of mean and variance only. simple problems

#### Module V

Normal curve – in terms of skewness and kurtosis, Characteristics and applications. Use of the table of Normal curve, Examples of applications of the normal curve. Concept of standard errors of measurement.

Standard scores – Z-score, T-Score, Stanine score, Converting raw scores into comparable standard normalized scores.

#### References

1. Garret E. Henry (2004). Statistics in psychology and education (11th ed): Paragon International publishers New Delhi.
2. Gravetter, F. J & Wallnau, L.B (2000). Statistics for Behavioral Science (5th ed.) Wadsworth-Thomson learning Singapore .
3. Aron, A, Aron. R, & Coups E. J. (2006). Statistics for psychology (4th ed.): Pearson Education , New Delhi.
4. Heiman W. Carry (2000). Basic statistics for behavioral science (3rd ed.), Houghton Mifflin Company ,New York.
5. Mangal ,S.k. (2000). Statistics in Psychology and Education.(2nd ed.): Prentice –Hall of India Private Limited, New Delhi.
6. Minium W. Edward, King M. Bruce & Bear Gordon (2001). Statistical Reasoning in Psychology and Education (3rd ed.), John Wiley & Sons, Inc., New York
7. Yule Undy G. & Kendal M.G. (1991). An Introduction To Theory of Statistics.(14th ed.), Universal Book Stall, New Delhi.

### COMPLEMENTARY COURSE TO FIRST DEGREE PROGRAMME FOR PSYCHOLOGY

#### IV SEMESTER- COMPLEMENTARY COURSE IV

#### ST1431.5: STATISTICAL METHODS FOR PSYCHOLOGY IV

**Credit: 3**

**Weekly hours: 3**

#### Module I

Statistical inference: Parameter, Statistic, Standard error, Sampling distributions, Sampling distribution of sample mean (without proof). Chi-Square, Student's-t, F statistics-definitions and use of tables, Inter relation between Chi-square, t and F statistics. Estimation theory-Point and Interval estimation, basic concepts, definition only, interval estimation problems based on Normal and t distributions .



**Module II**

Testing of Hypothesis : Procedure of testing of hypothesis ,Null and Alternative hypothesis ,Two types of errors, Significance level ,Power of the tests, Two tailed and One -tailed tests of significance. Simple problems on discrete case only.

**Module III**

Large sample tests- Testing the significance of mean , testing the significance of difference between two means , testing significance of proportion ,testing significance of difference between proportions. Chi-square Tests-Testing independence of attributes, coefficient of contingency , testing of goodness of fit.

**Module IV**

Small sample tests- Testing the significance of mean of Normal distribution ,testing the significance of difference between means of two Normal distribution ,paired-t test, testing correlation coefficient.

**Module V**

Non-parametric tests- When to use parametric and non-parametric tests, Sign tests ,Wilcoxon's matched-pairs signed rank test, Wald -Wolfowitz Run test, median test, Mc-Nemer test. Simple problems.(For problems table values to be provided in the question paper)

**References**

1. Garret E. Henry (2004). Statistics in psychology and education (11th ed): Paragon International publishers New Delhi.
2. Gravetter, F. J& Wallnau, L.B (2000). Statistics for Behavioral Science (5th ed.) Wadsworth-Thomson learning Singapore .
3. Aron, A, Aron. R, & Coups E. J. (2006). Statics for psychology (4th ed.): Pearson Education , New Delhi.
4. Heiman W. Carry (2000). Basic statics for behavioral science (3rd ed.), Houghton Mifflin Company ,New York.
5. Mangal ,S.k. (2000). Statiocs in Psychology and Education.(2nd ed.): Prentice -Hall of India Private Limited, New Delhi.
6. Minium W. Edward, King M. Bruce & Bear Gordon (2001). Stistical Reasoning in Psychology and Education (3rd ed.), John Wiley & Sons, Inc., New York
7. Yule Undy G. & Kendal M.G. (1991). An Introduction To Theory of Statics.(14th ed.), Universal Book Stall, New Delhi