St. TERESA'S COLLEGE, ERNAKULAM (AUTONOMOUS)

DEPARTMENT OF STATISTICS

SYLLABUS

Under Choice Based Credit and Semester System

(Effective from 2015 admission)

PREAMBLE

The Complementary courses in Statistics for the Bachelor's Programme in Mathematics, Physics and Sociology are framed by the Board of Studies using time tested and internationally popular text books so that the courses are at par with the courses offered by any other reputed university around the world.

Only those concepts that can be introduced at the under graduate level are selected and instead of cramming the course with too many ideas, the stress is given in doing the selected concepts rigorously. The course is framed in such a way that a student doing these courses will have developed the required analytical skills and logical reasoning required to identify problems, construct proofs and find solutions.

GRADUATE ATTRIBUTES

The Department of Statistics is committed to provide a culturally enriched educational experience that will transform the lives of its students. Our aspiration is for graduates who have developed the knowledge, skills and attributes to equip them for life in a complex and rapidly changing world.

On completion of the Complementary courses in Statistics, students should be able to demonstrate the graduate attributes listed below

- *Professionalism, employability and enterprise*
    - Proficiency in problem solving, creativity, numeracy and self-management.
    - Confidence in accepting professional challenges, act with integrity, set themselves high standards.
    - Ability to work independently and along a team with professional integrity.
- *Learning and research skills*
    - Acquire skills of logical and analytical reasoning.
    - Develop a critical attitude towards knowledge.
    - Equipped to seek knowledge and to continue learning throughout their lives.
    - Develop intellectual curiosity, effective learning and research abilities.
- *Intellectual depth, breadth and adaptability*
    - Proficiency in curricular, co-curricular and extracurricular activities that deepen and broaden knowledge
    - Develop skills of analysis, application, synthesis, evaluation and criticality.
- *Respect for others*
    - Develop self-awareness, empathy, cultural awareness and mutual respect.
    - Ability to work in a wide range of cultural settings and inculcate respect for themselves and others and will be courteous.
- *Social responsibility*
    - Knowledge in ethical behaviour, sustainability and personal contribution.
    - Awareness in the environmental, social and cultural value system.

OBJECTIVES

The syllabi are framed in such a way that it bridges the gap between the plus two and post graduate levels of Statistics by providing a more complete and logical frame work in almost all areas of basic Statistics.

By the end of the second semester, the students should have

1) Attained a secure foundation in Statistics to complement the core for their future courses.

By the end of the fourth semester, the students should have been

1) Introduced to powerful tools for tackling a wide range of topics in Standard distributions, Sampling distributions, Estimation and Testing of hypotheses.
2) Familiarized with additional relevant Statistical techniques and other relevant subjects to complement the core.

Course Code Format

Every course is coded according to the following criteria.

a. The first two letters of the code indicate the name of the discipline i.e. PH (Physics), EN (English).
   Kindly note the codes for the following departments so as to avoid repetition and confusion:
   History – HS, Hindi – HN

   Malayalam – ML, Maths – MT

   Computer Applications – CA, Communicative English – CE, Commerce – CO

   Physics – PH, Physical Education - PE

b. One digit to indicate the semester. E.g., PH1 (Physics, 1st semester), EN1 (English 1st semester)
c. One letter to indicate the type of course, such as Common Course (which includes English and Languages*) – A, Core Courses (Including Choice Based Electives) – B, Complementary Courses – C, Open courses – D. E.g. PH1A (Physics, 1st semester, Common Course), EN2C (English, 2nd Semester, Complementary Course)
d. One or two letters to indicate the Programme for which the complementary course is offered
e. Two digits to indicate the number of the course. All the courses are to be numbered continuously i.e., Core courses 01, 02, 03, etc., Common courses, 01, 02, etc., across the six Semesters. E.g. PH3B04 (Physics, 3rd Semester, Core Course, No 04), EN6B10 (English, 6th Semester, Core Course No 10)
f. One letter to indicate Theory/Practical, T or P. E.g. PH4B05P (Physics, 4th Semester, Core Course, No 05, Practical). This is applicable only to those disciplines such as Physics, Bharathnatyam, etc, that have Practical. Programmes that do not have Practical such as English **DO NOT** have to use this letter.
g. One letter to indicate the Programme, i.e. Bachelor's – B
   E.g. EN6B10B (English, 6th Semester, Core Course No 10, Bachelor's Programme), PH4B05PB (Physics, 4th Semester, Core Course, No 05, Practical, Bachelor's Programme).

Course Code::-

		A	B	C	D			
Discipline	Sem	Common/Core/Comple/Open				Course No.	Core	B
Programme								
2 letters	1 digit	1 letter				2 digits	1/2 letters	1 letter

Eg. ST1CMP01B, ST3CS01B

Scheme of Complementary Courses in Statistics

The following table shows the structure of the courses which indicates title of the courses, instructional hours and credits.

1. Statistics for B.Sc. Mathematics and Physics

Semester	Title of the paper	Course Code	Number of hours per week	Total Credits	Total hours/ semester	End Semester Assessment duration (hrs)
I	**Basic Statistics**	ST1CMP01B	4	3	72	3
II	**Probability and Random Variables**	ST2CMP02B	4	3	72	3
III	**Probability Distributions**	ST3CMP03B	5	4	90	3
IV	**Statistical Inference**	ST4CMP04B	5	4	90	3

2. Statistics for B.A. Sociology

Semester	Title of the paper	Course Code	Number of hours per week	Total Credits	Total hours/ semester	End Semester Assessment duration (hrs)
III	**Basic Statistics**	ST3CS01B	6	4	108	3
IV	**Statistical Tools**	ST4CS02B	6	4	108	3

Examinations:

The evaluation of each course shall contain two parts such as or In-Semester Assessment (ISA) and End-Semester Assessment (ESA) . The ratio between ISA and ESA shall be 1:4(20%: 80%)

Assessment Pattern:

Item	**Percentage**
In-Semester Assessment	**20**
End-Semester Assessment	**80**

In-Semester Assessment (ISA):

In-Semester Assessment is to be done by continuous assessments on the following components. The Components of the In-Semester Assessment for theory papers are as below.

Theory:

Component	**Marks**
Attendance	5
Assignment/Seminar	5
Average of two test papers	10

Attendance:

% of Attendance	**Marks**
>90%	5
Between 85 and 90	4
Between 80 and 85	3
Between 75 and 80	2
75 %	1
< 75	0

Assignments:

There will be one assignment per course in each of the first four Semesters.

In-Semester Assessment:

The evaluation of all components is to be published and is to be acknowledged by the candidate. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teach the course.

End-Semester Assessment:

The End-Semester examination of all courses shall be conducted by the College on the close of each semester. There will be no supplementary exams. For reappearance/ improvement, students can appear along with the next batch.

Pattern of Question Paper:

A question paper shall be a judicious mix of short answer type, short essay type/ problem solving type and long essay type questions.

For each course the Final Assessment is of 3 hours duration. The question paper has 4 parts. Part A is compulsory which contains 6 objective type questions each of 1 mark .Part B contains 10 short answer questions of which 7 are to be answered and each has 2 marks. Part C has 8 short essay questions of which 5 are to be answered and each has 6 marks. Part D has 4 long essay questions of which 2 are to be answered and each has 15 marks.

Part	No. of Questions	No. of questions to be answered	Marks
A (Objective type)	6	6	6x1 = 6
B (Short Answer)	10	7	7x2 = 14
C (Short Essay)	8	5	5x6 =30
D (Long Essay)	4	2	2x15 = 30

Note: A separate minimum of 30% marks each for sessional and final and aggregate minimum of 40% are required for a pass for a course.

Syllabus of Courses:

The detailed syllabus of the courses for complementary is appended.

For the Board of Studies in Statistics

Dr. Hitha N. (Chairperson)

Complementary Course to Mathematics & Physics
I Semester – Complementary – Statistics - Course I
ST1CMP01B -Basic Statistics

Objectives: 1) To introduce the basic concepts in Statistics
2) To develop data reduction techniques

Course Overview and Context :

This course introduces the basic concepts of Statistics. It outlines the techniques to expose the students to many Statistical ideas and rules that underlie Statistical reasoning

Syllabus Content

Hours per week – 4
Credits-3 **Total – 72 hours**

Module I (20 hours)

Introduction to Statistics, Population and Sample, Collection of Data, Various methods of data collection, Census and Sampling. Methods of Sampling – Simple Random Sampling– stratified sampling – systematic sampling (Method only), Types of data – quantitative, qualitative, Classification and Tabulation, Frequency Table, Diagrammatic representation – Bar diagram, pie diagram; pictogram and cartogram.

Module II (20 hours)

Measures of Central Tendency – Mean; Median; Mode; Geometric Mean; Harmonic Mean and Properties, Partition values- Quartiles, Deciles, Percentiles, Absolute and Relative measures of Dispersion – Range, Quartile Deviation, Box Plot, Mean Deviation, Standard Deviation, Coefficient of Variation.
Graphical representation – histogram, frequency polygon, frequency curve, ogives and stem and leaf chart.

Module III (16 hours)

Raw Moments, Central Moments, Inter Relationships (First Four Moments), Skewness – Measures – Pearson's, Bowley's and Moment Measure; Kurtosis- Measures of Kurtosis – Moment Measure, Measure based on partition values.

Module IV (16 hours)

Index Numbers – definition, limitations, uses, Simple Index Numbers; Weighted Index Numbers – Laspeyer's, Paasche's and Fisher's Index Numbers, Test of Index Numbers, Construction of Index Numbers, Cost of Living Index Numbers – Family Budget Method, Aggregate Expenditure Method.

Reference

1. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi).
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. B.L. Agarwal: Basic Statistics, New Age International (P) Ltd.
4. Parimal Mukhopadhya: Mathematical Statistics, New Central Book Agency (P) Ltd, Calcutta
   Murthy M.N.: Sampling theory and Methods, Statistical Publishing Society, Calcutta

Competencies of the course:

- Develop the fundamentals of Statistics, Present numerical facts through tables and graphs
- Summarise a mass of raw data into a meaningful form
- Describe the fundamental characteristics of data
- Know the general pulse of economy

Blue Print- ST1CMP01B -Basic Statistics

Module	1Mark 6/6	2Marks 7/10	6 Marks 5/8	15 Marks 2/4
I	1	2	2	--
II	2	3	2	2
III	2	3	2	1
IV	1	2	2	1

MODEL QUESTION PAPER

B.Sc. DEGREE EXAMINATION

First Semester

Complementary Course (Statistics)

ST1CMP01B – BASIC STATISTICS

(Common for MATHEMATICS, PHYSICS and COMPUTER APPLICATIONS)

Time: 3 hours Max.: 80 marks

Use of Scientific calculators and Statistical tables are permitted.

Part A (Short Answer Questions)

Answer ***all*** questions.

Each question carries 1 mark.

1. Define Simple random sampling
2. Define Mean deviation.
3. What is the Geometric mean of 16 and 25?
4. Give any 2 measures of Skewness.
5. The first two moments of a distribution about X = 4 are 1 and 4. Find the mean and variance.
6. What is commodity reversal test?

(6x1=6 marks)

Part B (Brief Answer Questions)

Answer any ***seven*** questions.

Each question carries 2 marks.

7. Give the sources of secondary data.
8. Distinguish between Census and sample survey.
9. Find the standard deviation of the numbers 7,9,16,24,26
10. Prove that the sum of deviations of observations from its A.M is zero.
11. What is the difference between a Bar diagram and a Histogram.
12. What is Kurtosis? Give the measure of Kurtosis in common use.
13. What is Sheppard's correction? What will be the correction for first four central moments?
14. Define Raw and Central moments.
15. If $\sum P_k = 360$, $\sum P_o = 300$ find the simple aggregate Index number.
16. Examine whether Laspeyer's Index number satisfies Factor reversal test.

(7x2 = 14 marks)

Part C (Short Essay Questions)

Answer any ***five*** questions.

Each question carries 6 marks.

17. Draw an ogive for the following data and hence find Median.

C. I:	25-40	40-55	55-70	70-85	85-100
F:	7	13	21	12	9

18. What are the parts of a table?
19. Explain Box Plot
20. Find Mean, Median and using the Empirical relation find Mode.

X:	4	8	12	16	20	24
F:	2	7	15	11	9	6

21. Establish the relation between Raw and Central moments.
22. For a distribution the Mean is 10, Variance is 16, $\beta_1 = 1$, $\beta_2 = 4$, Obtain the first four moments about 0
23. Explain the various steps involved in the Construction of an Index Number.

24. What are the limitations of an Index Number?

(5x6 = 30 marks)

Part D (Essay Questions)

Answer any ***two*** questions.

Each question carries 15 marks.

25. (a) What is an Ogive? Explain how the Ogive can be used to find out the Median and Quartiles?

(b) Explain Stem and Leaf Chart.

26. An Analysis of monthly wages paid to workers in two firms A and B belonging to the same Industry, gives the following results.

	Firm A	Firm B
No. Of wage earners	550	650
Average monthly wages	50	45
Variance of the distribution of wages	90	120

(a) Which firm A or B pays out larger amount as monthly wages?

(b) In which firm A or B is there greater variability in Individual wages?

(c) What are the measures of average and Standard deviation of monthly wages of all the workers in the two firms taken together ?

27. Calculate Laspeyer's , Paasche's and hence Fisher's Index numbers for the following data.

Commodity	Price(Rs per unit)		Quantity (Kg)	
	Base year	Current year	Base year	Current year
A	20	30	12	18
B	30	42	10	14
C	22	34	6	10
D	18	28	8	12

28. (a) Show that $\beta_2 > 1$ for a Discrete distribution.

(b) Calculate Pearson's Coefficient of Skewness for the following distribution

Variable	0-5	5-10	10-15	15 – 20	20 – 25	25 -30	30-35
Frequency	3	5	9	15	21	10	7

(2x15 = 30 marks)

Complementary Course to Mathematics & Physics

II Semester – Complementary – Statistics - Course II

ST2CMP02B-Probability and Random Variables

Objectives: 1) To introduce Probability theory as a foundation for Statistics.
2) To help students understand the basic notions about random variables.

Course Overview and Context :

This course explains step by step development of fundamental principles of Statistics, Probability concepts and Random variables.

Syllabus Content

Hours per week – 4
Credits-3 **Total – 72 hours**

Module I (16 hours)

Introduction to bivariate data. Correlation-Different types of Correlation. Concepts of Simple, Multiple and Partial Correlations. Simple Linear Correlation – Methods of finding simple linear Correlation – Scatter Diagram, Covariance Method, Rank Correlation (equal ranks).

Module II (16 hours)

Curve Fitting – Method of Least squares- Fitting of Straight Lines, Second Degree Equation, Exponential Curve, Power Curve. Simple Linear Regression – Regression Equations – Fitting and identification, properties.

Module III (20 hours)

Probability Concepts – Random Experiment, Sample Space, Events, Probability Measure, Approaches to Probability – Classical, Statistical and Axiomatic, Addition Theorem (upto 3 evens) Conditional Probability, Independence of events, Multiplication theorem (upto 3 events), Total Probability Law, Baye's Theorem and its applications.

Module IV (20 hours)

Random Variables – Discrete and Continuous, Probability Distributions – Probability Mass Function; Probability Density Function and Cumulative (distribution) function and their properties, change of variables (Univariate only), Bivariate random variables – Definition – Discrete and Continuous, Joint Probability Density Functions, Marginal and Conditional Distributions, Independence of Random Variables.

Reference

1. John E. Freund: Mathematical Statistics, Prentice Hall of India
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. S.P. Gupta: Statistical Methods, , Sultan Chand and Sons, New Delhi
4. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
5. Mood A.M., Graybill F.A. and Boes D.C. Introduction to Theory of Statistics, McGraw Hill.
6. B.R. Bhat, Modern Probability Theory, New Age International (p) Ltd.

Competencies of the course:

- Determine Degree of relationship between variables
- Nature of relationship and application of method of curve fitting
- Decisions in the face of uncertainty
- Explain the concepts of Probability distributions

Blue Print - ST2CMP02B-Probability and Random Variables

Module	1Mark 6/6	2Marks 7/10	6 Marks 5/8	15 Marks 2/4
I	1	3	2	1
II	2	2	2	1
III	1	2	2	1
IV	2	3	2	1

MODEL QUESTION PAPER

B.Sc. DEGREE EXAMINATION

Second Semester

Complementary Course (Statistics)

ST2CMP02B - PROBABILITY AND RANDOM VARIABLES

(Common for MATHEMATICS, PHYSICS and COMPUTER APPLICATIONS)

Time: 3 hours Max.: 80 marks

Use of Scientific calculators and Statistical tables are permitted.

Part A (Short Answer Questions)

Answer ***all*** questions.

Each question carries 1 mark.

1. Will the regression lines intersect and if so at which point?
2. Describe the principle of least squares used for estimation of parameters.
3. Write the Normal equations for fitting the curve $Y = ax^2 + bx + c$
4. Give the classical definition of probability.
5. What are the properties of a p.d.f of a discrete random variable?
6. Define conditional probability.

(6x1=6 marks)

Part B (Brief Answer Questions)

Answer any ***seven*** questions.

Each question carries 2 marks.

7. Show that $2r\sigma_x\sigma_y = \sigma_x^2 + \sigma_y^2 - \sigma_{x-y}^2$
8. What is a scatter diagram?
9. Find the angle between the regression lines if $\sigma_x = \sigma_y = 0.5$ and $\theta = \pi/4$
10. What are the different types of Correlation?
11. How can the two regression lines be identified?
12. Write the axioms of probability.
13. What is the probability of getting 53 Sundays in a leap year?
14. Distinguish between Discrete and Continuous random variables.
15. Can the following be a probability density function?

    g(x) = ½ for x = 1

    = 2/3 for x = 0

    = ¼ for x = 2 and 0 elsewhere.

16. Find k if $f(x) = kx(1-x)$; $0 \le x \le 1$ and 0 elsewhere is a p.d.f of a continuous random variable.

(7x2 = 14 marks)

Part C (Short Essay Questions)

Answer any ***five*** questions.

Each question carries 6 marks.

17. Fit a straight line of the form y = a + bx to the following data

X	0	1	2	3	4
Y	0	1.8	3.3	4.5	6.3

18. By the method of least squares find the regression line of Y on X
19. Derive the formula of Rank Correlation coefficient.
20. Show that the correlation coefficient is independent of origin and scale.
21. State and prove addition theorem of probability.
22. (a) Distinguish between Pair wise and Mutual independence of probability.

(b) Show that A and B are independent if and only if $P(B/A) = P(A/B^c)$

23. Define joint probability distribution function of a continuous random variable and state its properties.

24. If the distribution function of a random variable X is $F(x) = 0$ if $x \leq 0$; x if $0 \leq x \leq 1$; 1 if $x > 1$. Find the p.d.f of $Y = 2X + 3$

(5x6 = 30 marks)

Part D (Essay Questions)

Answer any ***two*** questions.

Each question carries 15 marks.

25. (a) State and prove Baye's theorem.

(b) The chances of A, B, C becoming Managers of a company are in the ratio 4 : 2 : 3. The probabilities that a reform will be introduced if A, B , C become Managers are 0.3, 0.5, 0.8 respectively. The reform has been introduced. What is the probability that B is appointed as the Manager?

26. The joint p.d.f of (X,Y) is given in the following table. Find

(a) The marginal distributions.

(b) f(x/ y = 3) and f(y/x= 2)

(c) $P(X \geq 2)$

(d) Examine whether X and Y are independent.

Y \ X	1	2	3
1	0.10	0.20	0.10
2	0.15	0.10	0.18
3	0.02	0.05	0.10

27. From the following data obtain the Pearson's coefficient of correlation

X	10	15	12	17	13	16	24	14	22
Y	30	42	45	46	33	34	40	35	39

28. Given the following data

Variance of x = 9, Regression equations are $8x - 10y + 66 = 0$ and $40x - 18y = 214$.

Find (a) mean values of x and y.

(b) the correlation coefficient between x and y

(c) the standard deviation of y

(2x15 = 30 marks)

Complementary Course to Mathematics & Physics

III Semester – Complementary – Statistics - Course III

ST3CMP03B - Probability Distributions

Objective: 1) To impart essential knowledge in Probability distributions
2) To expose the real-life applications of Probability distributions

Course Overview and Context :

This course explains the different types of Probability distributions with their real life applications.

Syllabus Content

Hours per week – 5
Credits-4 **Total – 90 hours**

Module I (25 hours)

Mathematical Expectation – Expectation of a Random Variable, Moments in terms of Expectations, Moment Generating Functions (m.g.f.) and its properties. Characteristic Functions and its Simple Properties, Conditional Expectation.

Module II (25 hours)

Discrete Probability Distributions – Uniform: Geometric; Bernoulli; Binomial; Poisson; Fitting of Distributions (Binomial and Poisson). Properties – Mean, Variance, m.g.f., Additive property; recurrence relation for moments (binomial and Poisson) Memorylessness property of Geometric distribution.

Module III (25 hours)

Continuous distributions – Uniform; Exponential; Gamma; Beta (type I and II); Normal; Standard Normal – definitions, Mean, Variance, m.g.f., Additive property, Memorylessness property of exponential distribution Fitting of Normal, Use of Standard Normal Tables for Computation of Various Probabilities.

Module IV (15 hours)

Tchebycheff's Inequality, Weak Law of Large Numbers, Bernoulli's Law of Large Numbers, Central Limit Theorem (Lindberg-Levy form) with proof.

Reference

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. Hogg, R.V. and Craig A.T. (1970). Introduction to Mathematical Statistics, Amerind Publishing Co, Pvt. Ltd.
3. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
4. Mood A.M., Graybill F.A. and Boes D.C. Introduction to Theory of Statistics, McGraw Hill
5. Johnson, N.L, Kotz, S. and Balakrishnan N. (1994). Continuous Univariate Distribution, John Wiley, New York.
6. Johnson, N.L, Kotz, S. and Kemp, A.W. : Univariate Discrete Distributions, John Wiley, New York.

Competencies of the course:

- Describe the four characteristics of a random variable
- Explain the various properties of some discrete random variables
- Bring out the applications of continuous distributions
- Describe the uses of Central limit theorem

Blue Print - ST3CMP03B - Probability Distributions

Module	1Mark 6/6	2Marks 7/10	6 Marks 5/8	15 Marks 2/4
I	2	3	2	1
II	1	2	2	1
III	2	3	2	1
IV	1	2	2	1

MODEL QUESTION PAPER

B.Sc. DEGREE EXAMINATION

Third Semester

Complementary Course (Statistics)

ST3CMP03B - PROBABILITY DISTRIBUTIONS

(Common for MATHEMATICS, PHYSICS and COMPUTER APPLICATIONS)

Time: 3 hours Max.: 80 marks

Use of Scientific calculators and Statistical tables are permitted.

Part A (Short Answer Questions)

Answer ***all*** questions.

Each question carries 1 mark.

1. State the addition theorem on Expectation for two random variables X and Y.
2. Define Moment generating function of a random variable.
3. If for a binomial distribution, p = ½, Then what will be the skewness of the distribution?
4. If X follows Uniform distribution over [0,1], then state the distribution of Y = - 2 log X.
5. Define Beta distribution of the first type.

6. State the Tchebychev's inequality.

(6x1=6 marks)

Part B (Brief Answer Questions)

Answer any ***seven*** questions.

Each question carries 2 marks.

7. For any two independent random variables X and Y, show that E (XY) = E(X) E(Y).
8. Define characteristic function of a random variable and state its important properties.
9. A balanced die is tossed. A person receives Rs. 10/- if an even number turns up. Otherwise he loses Rs. 8/-. How much money can he expect on the average in the long run?
10. Compute the mode of B(7, ¼).
11. If X is a Geometric random variable, calculate (i) P(X > 5) and (ii) P(X > 7|X > 2). State your conclusion.
12. If X ~ N(30, 5), find P[26 < X < 40].
13. Show that the mean and standard deviation of an exponential random variable with mean 3 are equal.
14. Obtain the moment generating function of a random variable X following Uniform distribution over (0, 2).
15. Two unbiased dice are tossed. If X is the sum of the numbers obtained, show that $P[|X - 7| \geq 3] \leq \frac{35}{54}$.
16. What are the assumptions in Lindberg-Levy form of Central Limit Theorem?

(7x2 = 14 marks)

Part C (Short Essay Questions)

Answer any ***five*** questions.

Each question carries 6 marks.

17. For a random variable X, $2\log M_X(t) = 30t + 90t^2$. Find its mean, variance and third central moment.
18. State and prove Cauchy-Schwartz inequality.
19. Derive the recurrence relation for raw moments of B(n, p).
20. Obtain Poisson distribution as a limiting form of Binomial distribution.
21. Show that Beta distribution of the first type can be obtained from Beta distribution of the second type by means of a transformation.

22. Show that QD: MD: SD = 10: 12: 15, for a Normal random variable with mean μ and Standard deviation σ.
23. State and prove Bernoulli form of Weak Law of Large Numbers. What are its assumptions?
24. How many trials should be performed so that the probability of obtaining atleast 40 successes is atleast 0.95, if the trials are independent and probability of success in a single trial is 0.2?

(5x6 = 30 marks)

Part D (Essay Questions)

Answer any ***two*** questions.

Each question carries 15 marks.

25. (a)Define conditional expectation and conditional variance.

    (b) If $f(x,y)= x+y$; $0<x<1$, $0<y<1$ is the joint p.d.f. of (X,Y), find correlation between X and Y.

26. (a) The following table gives the number of heads obtained in 30 repetitions when 4 biased coins were tossed. Fit an appropriate Binomial distribution and calculate the expected frequencies

No. of heads	0	1	2	3	4
Frequency	2	7	13	6	2

(b) What are the expected frequencies if the coins are assumed to be unbiased?

27. Derive the recurrence relation for central moments of a Normal distribution with parameters μ and σ and hence obtain β_1 and β_2.
28. A random sample of size 100 is taken from an infinite population with mean 75 and variance 256
    (a) Using Tchebychev's inequality, find P[67 < X < 83]
    (b) Using Central limit theorem, find P[67 < X < 83]

(2x15 = 30 marks)

Complementary Course to Mathematics & Physics

IV Semester – Complementary – Statistics - Course IV

ST4CMP04B-Statistical Inference

Objective: 1) To equip the students with the theory essential for estimation of unknown parameters and testing of hypotheses
2) To expose the students to its real-life applications.

Course Overview and Context :

This course introduces the methods of drawing conclusions about a population by analyzing and studying samples drawn from the population.

Syllabus Content

Hours per week – 5
Credits-4 **Total – 90 hours**

Module I (20 hours)
Sampling Distributions – definition, Statistic, Parameter, Standard Error, Sampling Distributions of Mean and Variance, χ^2, t and F (without derivation), properties, Inter relationships.

Module II (30 hours)
Concepts of Estimation, Types of Estimation – Point Estimation; Interval Estimation, Properties of Estimation – Unbiasedness, Efficiency; Consistency; Sufficiency. Methods of Estimation – MLE, Methods of Moments, Method of Minimum Variance, Cramer Rao Inequality (without proof), Interval Estimation for Mean, Variance and Proportion.

Module III (20 hours)
Testing of hypothesis- Statistical hypothesis, Simple and composite hypothesis Null and Alternate hypothesis, Type I and Type II errors, Critical Region, Size of the test, P value, Power, Neyman Pearson approach

Module IV (20 hours)
Large Sample tests – Z test, Chi-Square test-goodness of fit, test of independence. Small sample tests – Normal tests, t - test, Chi-square test, F- test.

Reference

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. Richard Johnson (2006): Probability and Statistics for Engineers (Miller and Freund). Prentice Hall.
3. S.C Gupta : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
4. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
5. Mood A.M., Graybill F.A. and Boes D.C. Introduction to Theory of Statistics, McGraw Hill.

Competencies of the course:

- Introduce the concepts of Statistic and Sampling distribution
- Explain the method of estimating parameters of a population
- Describe the procedure of testing of hypotheses
- Explain standard error and testing procedures for parameters of a Normal population using large and small samples

Blue Print - ST4CMP04B-Statistical Inference

Module	1Mark 6/6	2Marks 7/10	6 Marks 5/8	15 Marks 2/4
I	1	2	2	1
II	2	3	2	1
III	2	3	2	1
IV	1	2	2	1

MODEL QUESTION PAPER

B.Sc. DEGREE EXAMINATION

Fourth Semester

Complementary Course (Statistics)

ST4CMP04B – STATISTICAL INFERENCE

(Common for MATHEMATICS, PHYSICS and COMPUTER APPLICATIONS)

Time: 3 hours **Max.: 80 marks**

Use of Scientific calculators and Statistical tables are permitted.

Part A (Short Answer Questions)

Answer ***all*** questions.

Each question carries 1 mark.

1. What is the distribution of the ratio of two χ^2 variates?
2. Differentiate between Point estimation and Interval estimation.
3. If T is an unbiased estimate of θ, examine whether T^2 is unbiased for θ^2.
4. Define Power of a test.
5. Distinguish between simple and composite hypotheses with an example each.
6. Give the test statistic for testing the hypothesis H_0: $\sigma = \sigma_0$ against H_1: $\sigma \neq \sigma_0$ when the sample size is more than 30.

(6x1=6 marks)

Part B (Brief Answer Questions)

Answer any ***seven*** questions.

Each question carries 2 marks.

7. What do you mean by a sampling distribution?
8. Define t statistic. Give an example of a statistic that follows t-distribution.
9. Explain the method of moments for estimating unknown parameters of a population.
10. Explain interval estimate. Give the interval estimate of mean of a normal distribution when standard deviation is known.
11. Obtain the MLE of θ in $f(x, \theta)=1/\theta$, where $0 < x < \theta$
12. Explain the terms Type I error and Type II error.
13. To test the hypothesis that 25% of articles produced by a machine are defective against the alternative that 50% are defective, the test suggested was to take a sample size 5 and reject the hypothesis if number of defectives is greater than 1. Find the significance level and power of the test.
14. State Neyman Pearson lemma to obtain the best critical region.
15. Give the expression for the test statistic for testing the equality of the means of two normal populations when small samples are drawn from the populations with the same but unknown standard deviation.
16. Find the value of the χ^2 statistic from the following contingency table

	A_1	A_2
B_1	14	16
B_2	6	4

(7x2 = 14 marks)

Part C (Short Essay Questions)

Answer any ***five*** questions.

Each question carries 6 marks.

17. A sample of size 16 is drawn from a Normal population has variance 5.76. Find c such that $P[|\bar{x} - \mu| < c] = 0.95$, where $\bar{x}$ is the sample mean and μ is the population mean.
18. If $x_1, x_2, x_3, \ldots x_{16}$ is a random sample from a Normal population with mean 6 and standard deviation 2, find the distribution of

    (a) $\bar{x}$ (b) $\sum_{i=1}^{16}\left(\frac{x_i-6}{2}\right)^2$ (c) $\frac{\bar{x}-6}{\sqrt{\sum_{i=1}^{16}(x_i-6)^2}}$

19. Examine whether sample variance is an unbiased estimate of the population variance for a normal population. If not suggest an unbiased estimate for the population variance

20. State the Cramer –Rao inequality. Examine whether the parameter λ of a Poisson distribution admits a minimum variance unbiased estimator. Also find the lower bound for the variance of any unbiased estimator of λ.
21. The hypothesis H_0: $\theta = 2$ is accepted against H_1: $\theta = 5$ if $X \leq 3$, where X is the observation on a sample of size 1 from an exponential population with mean θ. Find α and β.
22. Obtain the most powerful test for testing H_0: $\theta = ¼$ against H_1: $\theta = ½$ based on a sample of size 2 say x_1 and x_2, if the p.d.f. in the population is $f(x) = \theta(1 - \theta)^x$;

    x = 1, 2, 3, . .
23. Explain the procedure for testing the equality of variances of two Normal populations when samples of sizes less than 30 are drawn from the populations.
24. Four coins are tossed 80 times. The distribution of the number of heads obtained are as follows

No. of heads:	0	1	2	3	4	Total
Frequency:	4	20	32	18	6	80

    Apply χ^2 test and test at 1% level whether the coins are unbiased.

(5x6 = 30 marks)

Part D (Essay Questions)

Answer any ***two*** questions.

Each question carries 15 marks.

25. (a)Let s_1 and s_2 be the sample standard deviations of two random samples of sizes n_1 and n_2 from two normal populations having the same unknown variance σ^2. Derive the probability distribution of $\frac{n_1 s_1^2 / n_1 - 1}{n_2 s_2^2 / n_2 - 1}$

    (b)The following data on the measurements of the fat content of two kinds of Ice creams brand A and brand B yielded the following results

Brand A	13.5	14.0	13.6	12.9	13.0
Brand B	12.9	13.0	12.4	13.5	12.7

    Find $P[\sigma_1^2 > 5.75\ \sigma_2^2]$ where σ_1^2 and σ_2^2 are the population variances
26. (a) X is uniformly distributed in (a,b). A sample of size 5 consists of the observations 3.1, 0.2, 1.6, 5.2 and 2.1. Find the moment estimates of a and b.

(b) A sample of 100 voters were asked to vote in a gallop poll. 55% of them voted in favour of the candidate. Find 95% and 99% confidence interval for proportion of voters who are in favour of the candidate.

27. Obtain the best critical region of size α for testing H_0: $\mu = 6$ against H_1: $\mu = 6.5$, where μ is the mean of a Normal population with variance 1, using a sample of size n.
Also find the power of this test when n = 4, 9, 16 and 25

28. Given the following contingency table test whether there is any association between hair colour and eye colour.

Eye colour	Hair colour		
	Blonde	Brown	Black
Blue	15	5	20
Grey	20	10	20
Brown	25	15	20

(2x15 = 30 marks)

Complementary Course to Sociology
III Semester – Complementary – Statistics - Course I
ST3CS01B - Basic Statistics

Objectives: 1) To introduce the basic concepts in Statistics
2) To develop data reduction techniques

Course Overview and Context :

This course introduces the basic concepts of Statistics. It outlines the techniques to expose the students to many Statistical ideas and rules that underlie Statistical reasoning

Syllabus Content

Hours per week – 6
Credits-4 **Total – 108 hours**

Module I (30 hours)

Meaning and Scope of Statistics – Importance , Limitations and Functions of Statistics. Collection of Statistical data from primary and secondary sources, Methods of collecting primary data , sources of secondary data and reliability of secondary data. Different scales of measurements.

Module II (18 hours)

Census and Sampling – Advantages and disadvantages, Limitations. Methods of Sampling- Simple random sampling. Stratified sampling, systematic sampling.(Methods only)

Module III (24 hours)

Classification and Tabulation, frequency tables – Discrete and continuous, Univariate and bivariate, Cumulative frequency distributions. Diagrammatic and Graphic representation of data: Diagrams- Bar diagrams, Pie diagrams, Pictograms and Cartograms. Graphs- Histograms, Frequency polygon, Frequency curves, Ogives.

Module IV (36 hours)

Measures of central tendency – Arithmetic Mean , Median , Mode , Properties of a good measure, Merits and demerits, Measures of Dispersion – Range , Quartile deviation , Standard deviation, Co-efficient of Variation, Properties of a good measure, Merits and demerits

Reference

1. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi).
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. B.L. Agarwal: Basic Statistics, New Age International (P) Ltd.

Competencies of the course:

- Explain the functions and uses of Statistics
- Distinguish between Census survey and Sample survey
- Represent quantitative data in the form of frequency distributions, diagrams and graphs
- Describe the fundamental characteristics of data

Blue Print - ST3CS01B - Basic Statistics

Module	1Mark 6/6	2Marks 7/10	6 Marks 5/8	15 Marks 2/4
I	1	2	2	1
II	1	1	1	1
III	2	3	2	1
IV	2	4	3	1

MODEL QUESTION PAPER

B.A. DEGREE EXAMINATION

Third Semester

Complementary Course (Statistics)

ST3CS01B – BASIC STATISTICS

(For B.A. Sociology)

Time: 3 hours Max.: 80 marks

Use of Scientific calculators and Statistical tables are permitted.

Part A (Short Answer Questions)

Answer ***all*** questions.

Each question carries 1 mark.

1. What is a primary data?
2. Define a random sample.
3. What is meant by tabulation of data?
4. Give any one example of a one dimensional diagram.
5. Define range.
6. Which is the most unstable measure of central tendency?

(6x1=6 marks)

Part B (Brief Answer Questions)

Answer any ***seven*** questions.

Each question carries 2 marks.

7. Distinguish between primary data and secondary data.
8. What are the limitations of Statistics?
9. Distinguish between population and sample.
10. Define discrete and continuous data.
11. What is meant by classification of data?
12. What is meant by geographical classification?
13. find the median of the following values:5,8,4,6,2,9,7.
14. Give the formula for finding the combined mean of 3 sets of observations.
15. Distinguish between simple arithmetic mean and weighted arithmetic mean.
16. Give the empirical relation between mean, median and mode.

(7x2 = 14 marks)

Part C (Short Essay Questions)

Answer any ***five*** questions.

Each question carries 6 marks.

17. What are the precautions to be taken before using secondary data?
18. Which are the different sources of collecting secondary data?
19. Explain lottery method of collecting simple random sampling.
20. What are the advantages of census over sampling?
21. Distinguish between a bar diagram and a histogram.
22. Write a short note on pie diagram.
23. Find the arithmetic mean of the data.

x	0	1	2	3	4	5
f	8	5	12	10	12	3

24. What are the requirements of a good measure of dispersion?

(5x6 = 30 marks)

Part D (Essay Questions)

Answer any ***two*** questions.

Each question carries 15 marks.

25. Explain the different sources of collecting primary data.

26. Explain the different methods of sampling.

27. Draw less than and greater than ogives for the following data and hence find the median.

class	0-20	20-40	40-60	60-80
frequency	7	16	13	4

28. Calculate the mean and median of the following data

Class	0-5	5-10	10-15	15-20	20-25
frequency	3	12	18	7	5

(2x15 = 30 marks)

Complementary Course to Sociology
IV Semester – Complementary – Statistics - Course II
ST4CS02B – Statistical Tools

Objectives: 1) To introduce Probability theory as a foundation for Statistics.
2) To equip the students with the theory essential for testing of hypotheses

Course Overview and Context :

This course explains the concepts of degree and nature of relationship between variables, introduces probability and random variables and explains testing of hypotheses.

Syllabus Content

Hours per week – 6
Credits-4 **Total – 108 hours**

Module I (24 hours)

Correlation and Regression: Simple Correlation- Scatter diagram, Karl Pearson's co-efficient of correlation, Spearman's Rank correlation. Simple linear regression, Regression lines- Identification of regression lines.

Module II (30 hours)

Random Experiment- sample space, event, -Algebra of events- classical and Statistical definition of probability- simple problems-Addition theorem of two events-statement only-conditional probability- Independence of events-elementary applications

Module III (30 hours)

Random variables (Discrete and Continuous) -probability density function- Binomial and normal distributions – Properties and Simple applications.

Module IV (24 hours)

Testing of hypothesis-Null and alternate hypothesis, significance level, power of the test, Z tests for means and proportion (one sample and two samples).

Reference:

1. S. P. Gupta: Statistical Methods, Sultan Chand and Sons, New Delhi.
2. S.C. Gupta and V.K. Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. Fundamentals of Statistics: DN Elhance, Kitab Mahal, Allahabad.

Competencies of the course:

- Determine Degree of relationship between variables
- Predict the value of the dependent variable when the corresponding value of the independent variable is known
- Introduce the concept of probability and random variables
- Explain standard error and testing procedures for parameters of a Normal population using large samples

Blue Print - ST4CS02B – Statistical Tools

Module	1Mark 6/6	2Marks 7/10	6 Marks 5/8	15 Marks 2/4
I	2	2	2	1
II	1	3	2	1
III	1	3	2	
IV	2	2	2	2

MODEL QUESTION PAPER

B.A. DEGREE EXAMINATION

Fourth Semester

Complementary Course (Statistics)

ST4CS02B – STATISTICAL TOOLS

(For B.A. Sociology)

Time: 3 hours **Max.: 80 marks**

Use of Scientific calculators and Statistical tables are permitted.

Part A (Short Answer Questions)

Answer ***all*** questions.

Each question carries 1 mark.

1. What are the limits within which the correlation coefficient should lie?
2. What is the relation between correlation coefficient and regression coefficients?
3. Define a random experiment.
4. Define probability density function.
5. Define null and alternative hypotheses.
6. What is meant by power of a test?

(6x1=6 marks)

Part B (Brief Answer Questions)

Answer any ***seven*** questions.

Each question carries 2 marks.

7. What is a scatter diagram?
8. Give the expression for spearman' rank correlation coefficient.
9. State the addition theorem on probability for 2 events.
10. Define the following: (i) sample space (ii) mutually exclusive events.
11. Which are the axioms of probability? Also prove that $P(A^c) = 1 - P(A)$
12. Distinguish between discrete and continuous random variables.
13. Define expectation of a random variable.
14. Define distribution function of a random variable. State its properties
15. What is a one tailed test?
16. Define a binomial distribution.

(7x2 = 14 marks)

Part C (Short Essay Questions)

Answer any ***five*** questions.

Each question carries 6 marks.

17. Explain the different types of correlation.
18. What are the properties of the regression coefficients?
19. Write down the sample space of selecting families with two children each.
20. Define conditional probability and state multiplication theorem for independent events.
21. A random variable X follows a probability distribution as given below:

x	0	1	2	3
f(x)	$\frac{k}{2}$	$\frac{k}{3}$	$\frac{k+1}{3}$	$\frac{2k-1}{6}$

Find the value of k. also find the mean and variance of the variable.

22. For a binomial distribution mean= 4 and variance = 12/9. Write down the distribution.
23. Explain the two types of errors in testing of hypotheses.
24. A problem is given to 2 students. Their chances of solving the problem are ½ and ¾. What is the probability that the problem is solved?

(5x6 = 30 marks)

Part D (Essay Questions)

Answer any ***two*** questions.

Each question carries 15 marks.

25. Find the values of $\bar{x}$ and $\bar{y}$ if the regression lines are x+2y-5 = 0 and 2x+3y-8 = 0. Also find the coefficient of correlation.
26. (a) Define normal distribution and state its important properties.

    (b) In a distribution 7% of the items are under 35 and 89% are under 63. What are the mean and standard deviation of the distribution?
27. The heights of students studying in college classes is believed to be distributed with S.D. is 1.5. A sample of 400 students has their mean height 4.75ft. Does this contradict the hypothesis that the mean height of students is 4.48ft.(significance level $\alpha = 0.01$)
28. In a sample of 600 men from a certain city 400 are found to be smokers. Out of 900 from another city 450 are smokers. Do the data indicate that cities are significantly different as far as smoking habits of people are concerned? (significance level $\alpha = 0.05$)

(2x15 = 30 marks)
