

## **Revised Syllabus of S.Y.B.Sc. Statistical Techniques**

1. A student of the three year B.Sc. course shall not be allowed to offer Statistics and Statistical Techniques simultaneously in any of the three years of the B.Sc. course.
2. Students offering Statistical Techniques in the first year of the three year B.Sc. course may be allowed to offer Statistical Techniques at S.Y.B.Sc. level, provided they satisfy other relevant conditions, if any.
3. Students offering Statistics in the first year of the three year B.Sc. course may be allowed to offer Statistical Techniques at S.Y.B.Sc. level.
4. Students offering Statistical Techniques shall not be eligible for admission to the M.A./M.Sc. Statistics course.
5. The student must complete all practicals in each practical course to the satisfaction of the teacher concerned.
6. The student must produce at the time of the practical examination his/her laboratory journal along with the completion certificate signed by the Head of the Department of Statistics
7. Out of the 100 marks for each practical paper, 20 marks are reserved for the internal assessment . Out of the 80 marks 10 marks are reserved for the Viva-voce and the practical shall carry 70 marks.
8. In this subject, the emphasis is to be placed on the statistical concepts and techniques rather than on mathematical derivations and proofs.
9. Statistical Techniques cannot be offered at T.Y.B.Sc. level.
10. Duration of the practical examination be extended by 10 minutes to compensate for the loss of time of the Viva-voce of the candidate.

**S.Y.B.Sc. Semester I, paper-I**  
**Statistical Techniques**  
**Paper: STT 211 : Statistical Techniques-I**

1. Discrete Probability Distributions:

1.1 Geometric Distribution : ( 6 )

Probability Mass Function. Statement of the distribution function. Statement of mean, variance. Computation of probabilities. Recurrence relation for the probabilities. Illustrations of the real life situations where Geometric distribution is applicable. Geometric distribution as a Waiting Time Distribution. Lack of memory property.

1.2 Negative Binomial Distribution: ( 8 )

Probability Mass Function. Statement of mean, variance. Computation of probabilities. Additive property. Recurrence relation for the probabilities. Illustrations of the real life situations where negative binomial distribution is applicable.

1.3 Multinomial Distribution ( Up to three variables only ) : ( 6 )

Recurrence relation for the probabilities. Computation of probabilities. Illustrations of the real life situations where Multinomial distribution is applicable. Marginal distributions (Statement only).

2. Continuous Probability Distributions:

2.1 Exponential Distribution : ( 6 )

Probability Density Function ( p.d.f.)

$$f(x) = \begin{cases} \alpha e^{-\alpha x}, & x > 0, \alpha > 0 \\ 0 & \text{elsewhere.} \end{cases}$$

Nature of probability curve. Statement of the distribution function. Statement of mean, variance. Computation of probabilities. Quartiles, Deciles and Percentiles. Illustrations of the real life situations where exponential distribution is applicable. Lack of memory property.

2.2 Normal Distribution :

( 14 )

p.d.f., Nature of probability curve. Statement of mean, variance. Standard normal distribution. Symmetry of distribution. Computation of probabilities using normal probability tables. Quartiles, deciles and percentiles. Normal approximation to the binomial distribution (Statement only). Illustrations of the real life situations where normal distribution is applicable.

3. Multiple Regression and Multiple and Partial Correlation:

(10)

- 3.1 Notion of multiple regression, Yule's notation ( trivariate case – sample data only.)
- 3.2 Fitting of regression plane by the method of least squares. Normal equations.  
Definition of partial regression coefficients ( $b_{ij,k}$ )
- 3.3 Definition of multiple correlation coefficient ( $R_{i,j,k}$ ). Properties of multiple correlation coefficient.
- 3.4 Definition of partial regression coefficient ( $r_{ij,k}$ )

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**Semester I, paper-II**  
**Paper: STT 212:Statistical Techniques-II**

1. Simple Random Sampling (8)
  - 1.1 Simple random sampling with and without replacement (SRSWR and SRSWOR), Real life situations where SRS is used.
  - 1.2 Listing of all possible samples of given size drawn by SRSWOR from a given finite population.
  - 1.3 Finding probability associated with an element at a draw, probability of inclusion of an element.
  - 1.4 Statements regarding estimates of population mean, population total, their standard errors, estimates of the standard errors and verification of these results through simple numerical problems.
  
2. Sampling for proportions (6)
  - 2.1 Real life situations where sampling for proportions is used. Sampling for proportions as a particular case of Simple Random Sampling.
  - 2.2 Statements regarding estimates of population proportion, population total, their standard errors, estimates of the standard errors.
  - 2.3 Use of hypergeometric ( in case of SRSWOR ) and binomial ( in case of SRSWR ) distributions to derive the formulae regarding standard errors. Simple numerical problems to illustrate the above ideas.
  
3. Stratified Random Sampling (10)
  - 3.1 Real life situations where stratification is needed.
  - 3.2 Statements regarding estimates of population mean, population total, their standard errors (simple random sampling is used in each stratum), estimates of the standard errors.
  - 3.3 Problems of allocation, statements regarding strata sample sizes in proportional and optimum allocations, statements regarding estimates of the standard errors when these allocations are used.
  - 3.4 Illustrative numerical examples.

4. Acceptance sampling for attributes:

Principles of acceptance sampling:

Concept of single sampling plan.

Computation of probability of acceptance in case of single sampling plan (evaluation of probability of acceptance using hypergeometric, binomial and Poisson distributions).

Explanation of the terms: AQL, LTPD, LTFD, Producer's risk ( $P_p$ ), Consumer's risk ( $P_c$ ), AOQ, AOQL, ATI. Computation of Producer's risk ( $P_p$ ), Consumer's risk ( $P_c$ ), AOQ, ATI.

OC, AOQ and ATI curves. Determination of AOQL graphically. Simple numerical problems.

Concept of double sampling plan.

Computation of probability of acceptance in case of double sampling plan (evaluation of probability of acceptance using Poisson distribution).

Explanation of the terms: AQL, LTPD, LTFD, Producer's risk ( $P_p$ ), Consumer's risk ( $P_c$ ), AOQ, AOQL, ATI. Computation of Producer's risk ( $P_p$ ), Consumer's risk ( $P_c$ ), AOQ, ATI.

OC, AOQ and ATI curves. Determination of AOQL graphically. Simple numerical problems.

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**S.Y.B.Sc. Semester II , paper-I**  
**Paper: STT 221:Statistical Techniques III**

1. Sampling Distributions: (4)

Definitions of random sample, statistic. Sampling distribution of a statistic, standard error of a statistic.

2. Tests of hypotheses: (12)

Types of hypotheses, critical region.

- 2.1 Concept of a test of hypothesis, level of significance, one- tailed and two- tailed tests, concept of large sample tests and small sample tests.

- 2.2 Large sample tests for means : one sample and two sample tests for one sided and two sided alternatives.

- 2.3 Large sample tests for proportions : one sample and two sample tests for one sided and two sided alternatives.

3. Chi-Square Distribution : (12)

3.1 Chi-Square distribution as a distribution of sum of squares of n independent standard normal variates, Nature of probability curve. Statement of mean, variance. Additive property. Computation of probabilities using Chi-Square probability tables (approximation to normal not expected).

3.2 Chi-square test of goodness of fit.

3.3 Chi-square test for independence of attributes.

3.4 Chi-square test for population variance for one sided and two sided alternatives when mean is known and unknown (Yates correction not expected).

4. t- Distribution : (6)

- 4.1 Definition of t- variate with n d.f. in the form

$$t = \frac{U}{\sqrt{V/n}} \quad \text{where } U \sim N(0,1) \text{ and } V \sim \chi^2_n$$

U and V are independent.

Computation of probabilities using t- tables.

- 4.2 t-test for population mean for one sided and two sided alternatives.
- 4.3 Paired t test.

5. F distribution (6)

- 5.1 F-distribution as a distribution of the ratio of two independent chi-square variates. Nature of probability curve. Computation of probabilities using F- tables.
- 5.2 F-test for the equality of two population variances for one sided and two sided alternatives.

6. Analysis of variance (ANOVA) (10)

- 6.1 One- way analysis of variance:  
Model, assumptions and interpretation. Hypothesis to be tested, interpretation of ANOVA table and use of F-test.
- 6.2 Two- way analysis of variance:  
Model, assumptions and interpretation. Hypotheses to be tested, interpretation of ANOVA table and use of F-test.

(estimation of parameters and justification of F-test is not expected in one- way and two- way analysis of variance)

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## Paper: STT 222:Statistical Techniques-IV

### 1. Statistical Quality Control (SQC) (10)

1.1 Introduction: Meaning and purpose of SQC, quality of a product, Need of quality control, statistical quality control, process control, lot control.

1.2 Control Charts: Chance and assignable causes of variation, probability limits, 3-sigma limits. Criteria for detecting lack of control: (a) point outside control limits, (b) non random variation within the control limits of the following type: a run of seven or more points above or below the central line, presence of linear trends and cycles.

### 1.3 Control charts for continuous variables ( R chart and $\bar{X}$ chart) (16)

Purpose of R chart and  $\bar{X}$  chart, construction of R chart when the process standard deviation is not given, control limits, drawing of control chart, plotting sample range values. Drawing conclusions: determination of the state of process, necessity of revision of control limits, estimate of  $\sigma$ . construction of  $\bar{X}$  chart when the process average is not given, control limits, drawing of control chart, plotting sample average values. Drawing conclusions: determination of the state of process, necessity of revision of control limits, estimate of  $\mu$  for future use. Identification of real life situations. Simple numerical problems.

### 1.4 Control charts for attributes: (12)

(i) p- chart when subgroup size is fixed and the value of the process fraction defective is not specified. Control limits, Drawing of control chart, plotting sample fraction defective values. Drawing conclusions: determination of the state of process, necessity of revision of control limits, estimate of P. Identification of real life situations. Simple numerical problems. Interpretation of high and low spots.

(ii) p chart when subgroup size is varying

(a) separate control limits

(b) stabilized control limitsfor Z- chart.

(iii) C-chart: C- chart when standard is not given, Control limits, Drawing of control chart, plotting number of defects per unit, . Drawing conclusions: determination of the state of process, necessity of revision of control limits, estimate of C. Identification of real life situations. Simple numerical problems. Interpretation of high and low spots.



2. Reliability: (12)

2.1 Series system, parallel system of components less than five.

2.2 Reliability block diagram of a system of components.

2.3 Structure function of a given system

2.4 Reliability of a system when components are independent and identically distributed with component reliability ( $p$ ).

2.5 computation of reliability ( $p$ ) of component using exponential distribution.

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**Books Recommended :**

1. Introduction to Statistics by Ronald E. Walpole( Macmillan Pub. Co.)
2. Probability and Statistics for Engineers and Scientists by Ronald E. Walpole ( Macmillan Pub. Co.)
3. Probability and Statistics ( Schaum's Outline Series) by Murray and Spiegel (McGraw Hill Pub. Co.)
4. Statistics for Management by Richard L. Levin and David S. Rubin (Prentice Hall of India Pvt. Ltd.)
5. Sampling Techniques by W. G. Cochran.
6. Theory and Analysis of Sample Survey Design by Daroga Singh and Chaudhary F. S. (Wiley Publications Ltd.)
7. Statistical Quality Control by Grant E.L. (McGraw Hill Book Co.)
8. Quality Control and Industrial Statistics by Duncan A.J. (D.b. Taraporwala Sons and Co. Pvt. Ltd.)
9. Introduction to Statistical Quality Control by Montgomery D. (John Wiley and Sons.)
10. Statistical Methods by Gupta S.P. (Sultan Chand and Sons.)
11. Fundamentals of Applied Statistics by Kapoor V.k. and Gupta S.C. (Sultan Chand and Sons.)
12. Probability and Statistics with Reliability, Queuing and Computer Science by Trivedi ( John Wiley and Sons.)
13. Common Statistical Tests by Kulkarni M.B., Ghatpande S.B. and Gore S. (Satyajit Prakashan, Pune)

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## Practical

**Pre-requisites:** Knowledge of the topics in theory papers.

**Objectives:** At the end of this course students are expected to be able

1. to compute multiple, partial and correlation coefficients,
2. to fit probability distributions such as Negative binomial, Normal,
3. to analyse data related to statistical quality control (SQC), analysis of variance ( ANOVA),
4. to carry out large sample and small sample tests of significance,
5. to compute and interpret summary results of the data,
6. to interpret summary statistics of computer output.

**S.Y.B.Sc.**  
**Statistical Techniques (practical paper)**  
**Paper : STT 223**

| <b>Sr. No.</b> | <b>Title of Experiment</b>   | <b>No. of Experiments</b> |
|----------------|--|---------------------------|
| 1              | Fitting of Negative Binomial Distribution  | 1                         |
| 2              | Applications of Negative Binomial Distribution   | 1                         |
| 3              | Fitting of Normal Distribution   | 1                         |
| 4              | Fitting of Normal Distribution using MS-EXCEL/SPREAD SHEET                               | 1                         |
| 5              | Applications of Normal Distribution  | 1                         |
| 6              | Simple Random Sampling (SRSWR and SRSWOR)  | 1                         |
| 7              | Stratified Random Sampling - I   | 1                         |
| 8              | Stratified Random Sampling - II  | 1                         |
| 9              | Fitting of Regression Plane  | 1                         |
| 10             | Fitting of Regression Plane using MS-EXCEL/SPREAD SHEET                                  | 1                         |
| 11             | Computation of Multiple and Partial Correlation Coefficients                             | 1                         |
| 12             | Computation of Multiple and Partial Correlation Coefficients using MS-EXCEL/SPREAD SHEET | 1                         |
| 13             | Large Sample Tests for Proportions   | 1                         |
| 14             | Large Sample Tests for Means   | 1                         |
| 15             | Tests based on Chi-square Distribution-I ( Tests for variance)                           | 1                         |
| 16             | Tests based on Chi-square Distribution-II  | 1                         |
| 17             | Tests based on t and F-distributions   | 1                         |
| 18             | Single Sampling Plan   | 1                         |
| 19             | Double Sampling Plan   | 1                         |
| 20             | Control Charts for Variables ( X and R charts )  | 1                         |
| 21             | Control Chart for attribute ( P – chart when subgroup size is (i) fixed, (ii) variable   | 1                         |
| 22             | C – chart  | 1                         |
| 23             | Analysis of variance ( ANOVA for one - way classification)                               | 1                         |
| 24             | Analysis of variance ( ANOVA for two - way classification)                               | 1                         |