DEPARTMENT OF STATISTICS, BANGALORE UNIVERSITY

Proceedings of the Meeting of the Board of Studies in Statistics (UG & PG) held at 10:30 am on 17.06.2014 in the Department of Statistics

Members Present:
1. Prof. J. V. Janhavi
   Department of Statistics, BUB
2. Dr. V. Srinivas
   Department of Statistics, BUB
3. Dr. G. Nanjundan
   Department of Statistics, BUB
4. Dr. Paramehwar, V. Pandit
   Department of Statistics, BUB
5. Prof. M. R. Srinivasan
   Department of Statistics
   University of Madras
   Chennai
6. Smt. Radhamani
   Associate professor of Statistics
   Karnatak University, Dharwad
7. Smt. Mamata Ramesh
   Department of Statistics
   MES College of Arts, Commerce & Science
   Bangalore
8. Sri. R. Prakash
   Vijaya College, Basavangudi
   Bangalore.
9. Mr. G. T. Rajashekaraih
   Vijaya College Jayanagar, Bangalore
10. Dr. M. R. Ramesh
    Vijaya College
    Bangalore
11. Prof. P. Rajalakshmi
    Chairperson BOS in Statistics, BUB

The Chairperson welcomed the members to the meeting of the Board of Studies.

1. The members of the board approved the panel for UG and PG examinations for December 2014/January 2015 and May/June 2015

2. The Chairperson presented the draft of the revised syllabus of Statistics and the scheme for examination for the B.Sc course. After the detailed deliberation by the members of the board, the suggestion made by the members were incorporated and it was approved for the admission 2014 onwards.
3. The Chairperson presented the draft of the revised syllabus and scheme for the examination for the M.Sc (Statistics) course. After the detailed deliberation by the members of the board the list of papers were approved for the admission 2014 onwards and the Syllabus of some papers were approved and a few papers will be finalized by circulation among the members.

4. The panel of Examiners for the Ph.D candidate Mr. T. Raveendra Naik under the guidance of Dr. G. Nanjundan has been approved with a few modifications.

Prof. J.V. Janhavi
Dr. V. Srinivas
Dr. M.R. Ramesh
Dr. G. Nanjundan
Dr. P. V. Pandit
Smt. Radhamani
Prof. M.R. Srinivasan
Sri. R. Prakash
Smt. Mamata Ramesh
Mr. G.T. Rajasekaraiah,
Prof. P. Rajalakshmi

Member absent: Prof. B Ismail, Department of Statistics, Mangalore University, Mangalore
BANGALORE UNIVERSITY
Three year B.Sc. Course (CBCS 2014)

REGULATIONS AND SYLLABUS IN STATISTICS

ELIGIBILITY:
1. To be eligible to take Statistics as one of the optional subjects in B.Sc. course, a student must have passed Pre-University course or an equivalent course with Mathematics /Business Mathematics / Basic Mathematics / Applied Mathematics as one of the optional subject.
2. Any student taking Statistics as one of the optional subjects in the B.Sc. Course must have Mathematics as another optional subject.

SCHEME OF INSTRUCTION / EXAMINATION:
1. The subject of Statistics in this course has to be taught by a master degree holder in Statistics / Applied Statistics.
2. The theory question paper should cover all the topics in the syllabus with proportional weightage to the number of hours of instruction allotted.
3. The list of practicals is given under each paper in the syllabus
4. The practicals are to be conducted in batches as per university norms for science faculty (Ordinarily 10 students per batch per teacher)
5. Two teachers are to be assigned for each batch with not more than 20 students for giving instructions, supervision, and correction of records.
6. It is expected that each student collects and uses real life data for the practical classes.
7. Students are required to use the Statistical software, run the programmes and computer outputs obtained in practical classes are to be enclosed in the practical record for computer based practicals.
8. In practical examination a maximum of 5 marks are allotted for practical record.
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<tr>
<th>Sem</th>
<th>Code number</th>
<th>Title of the paper (Theory / Practical)</th>
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Total Credits-24
B.Sc. Course in Statistics
First Semester
4 hours lecture +3 hours practical per week
(Theory 2 credits + Practicals 1 credit)

ST 101: Basic Statistics –I

Unit 1. : Organization and presentation of data :
Statistics-importance and scope .Basic concepts & Types of data ,Statistical investigation , collection of
data- primary and secondary data , questionnaire and schedule, Census & sampling - Classification &
tabulation –Construction of Statistical table and frequency distribution , Diagrammatic and graphical
representation of data .

52 hours

Unit 2. Univariate data analysis: Numerical summary measures- Central tendency, Dispersion , Moments,
Skewness ,Kurtosis –properties and applications.

12 hours

Unit-3: Basics of Probability: Random experiments, trial, sample space & events-related results.
Classical, empirical and axiomatic approaches to probability – illustrations and applications. Addition
rule, Conditional probability, independence of events and multiplication rule , Total probability rule,
Bayes’ theorem applications.

13 hours

Unit-4: Random variables and Mathematical expectation- (One dimension )
Discrete and continuous random variables, Distribution function ,probability mass and density
functions- properties and illustrations. Expectation of a random variable and rules of expectation &
related results : Moments & moment generating function - properties and uses . Chebyschev’s inequality
- proof and its use in approximating probabilities. Transformation of random variables.

10 hours

Unit-5: An Introduction to R-Software
Computer software and utility, statistical soft wares. R-software- Essentials, advantages, expressions,
and objects. Functions and arguments, matrices and arrays, factors, data frames, graphs, Data entry,
reading from a text file, the data editor, interfacing to other programmes, Descriptive statistics and
graphics-summary statistics, graphical display of distributions.

12 hours

ST 102 : Practical –I :– List of practicals
(Demonstration of practicals using R-Software)
1. Classification & Tabulation of data.
2. Diagrammatic representation of data.
3. Construction of frequency distribution & Graphical representation.
4. Measures of central tendency I (Mathematical averages)
5. Measures of central tendency II (Positional averages & Partition values)
6. Measures of dispersion I (Range, QD & MD)
7. Measures of dispersion II (SD & CV)
8. Moments, Skewness and Kurtosis for a frequency distribution.
9. Computation of probabilities using combinatorial methods
10. Application of addition and multiplicative rules and Bayes’ formula.
11. Univariate probability distribution-Expectation,Positional measures, moments,
skewness and kurtosis.
12. Applications of Chebyschev’s inequality.
Text Books:

References:

B.Sc. Course in Statistics
Second Semester
4 hours lecture +3 hours practical per week
(Theory 2 credits + Practicals 1 credit)

ST 201: Basic Statistics –II

Unit-1: Discrete Probability distributions.

12 hours

Unit-2: Continuous Probability distributions.
Uniform, Gamma, Beta and Exponential distributions – definition through p.d.f.s. Mean, variance, moments and m.g.f. Additive property of Exponential and Gamma variates. Lack of memory property of Exponential distribution. Normal distribution and its properties. Cauchy distribution. Chi-square, t and F distributions- Definitions through p.d.f, their properties and applications.

18 hours

Unit-3: Random variables and Mathematical expectation- (Two dimension)

52 hours

Unit 5: Multivariate Data Analysis: Multiple linear regression, multiple correlation and partial correlation coefficients, Residual variance.

ST 202: Practical –II: – List of Practicals
(Demonstration of Practicals using MS-Excel & R-Software)

1. Binomial, Hypergeometric & discrete uniform distributions -Applications
2. Poisson, Negative binomial & geometric distributions -Applications
3. Normal distribution -Applications
4. Rectangular and exponential distributions- Applications
5. Bivariate probability distribution-1: moments, and correlation coefficient.
7. Fitting first and second degree curves.
8. Fitting exponential and geometric curves.
9. Correlation and regression for ungrouped data.
10. Correlation and regression for grouped data
11. Spearman’s rank correlation.
12. Analysis of Trivariate data.

Text Books:

References:
B.Sc. Course in Statistics
Third Semester
4 hours lecture + 3 hours practical per week
(Theory 2 credits + Practicals 1 credit)
ST 301: Sampling Theory and Estimation
52 hours

Unit -1: Introduction to Sampling Theory & Sampling distribution:
Concepts of population and sample. Need for sampling- complete enumeration vs sample surveys.
Probability and Non-probability sampling – Methods of drawing random samples. Survey methods;
principal steps in a sample survey, planning, execution, analysis and reporting stages. Sampling & non-
sampling errors. Sampling distribution and Standard error. Sampling distribution of mean and variance.
6 hours

Unit-2: Simple random sampling
Sampling with and without replacement. Unbiased estimators of population mean and total. Derivation
of sampling variances. Sampling for proportions. Derivation of the sampling variances. Standard errors
and confidence limits. Determination of sample size. - Advantages and limitations of SRS.

Unit-3: Stratified and Systematic sampling
Stratified random sampling- Need for stratification - Advantages and limitations. Unbiased estimators of
population mean and total. Derivation of the variance of the estimators and their estimation.
Proportional, Optimum and Neyman allocations. Comparison of variances with SRSWOR. Estimation
of gain in precision due to stratification.
Linear Systematic sampling - Advantages and limitations. Estimation of mean, total and variance of the
estimator. Comparison with SRSWOR and stratified random sampling. Circular systematic sampling.

Unit-4: Point Estimation:
Families of distributions. Location and scale family. Single parameter exponential family. Point
estimation. Concepts of estimator and estimate. Criteria for a good estimator-Unbiasedness, Consistency,
criteria for consistency, Invariance property of consistent estimator. Efficiency, Relative efficiency.
Mean square error as a criterion for comparing estimators. Sufficient Statistic. Statement of Neyman -
Minimum variance unbiased estimator and Minimum bound estimator.
Methods of Point Estimation: Maximum likelihood Estimator and Moment Estimators - Properties
and examples.

Unit-5: Interval estimation:
Confidence interval, Confidence coefficient, shortest confidence interval. Pivotal quantity method of
constructing Confidence interval. Construction of confidence intervals for mean, difference of two
means, variance and ratio of variances, proportion, difference of two proportions and correlation
coefficient.

ST 302: Practical –III :- List of practicals
(Demonstration of practicals using MS-Excel & R-Software.)

1. Drawing random samples and Construction of sampling distribution of sample
mean and sample variance.
2. Drawing of random sample under SRSWR and SRSWOR from a given
Population and estimation of the mean and total and the standard error of the
estimators. Construction of confidence intervals.

20 hours

06 hours
3. Estimation of the proportion, total and the standard error of the estimator based on a random sample under SRSWR and SRSWOR.
4. Estimation of the mean, total and the standard error of the estimators under stratified random sampling.
5. Comparison of the precisions of the estimators under various allocations and that under SRSWOR and Estimation of gain in precision due to stratification.
7. Systematic sampling
& Comparison of estimators by plotting mean square error.
10. Interval Estimation-I: Construction of confidence intervals (large sample )
11. Interval Estimation-II: Construction of confidence intervals (small sample )

Text Books:
Sultan Chand & Co.
MacMillan.
Statistics, McGraw Hill.
design. (Wiley Eastern).

References
and Co.)
Calcutta)
B.Sc. Course in Statistics  
Fourth Semester  
4 hours lecture + 3 hours practical per week  
(Theory 2 credits + Practicals 1 credit)  

ST 401: Testing of Hypotheses  
52 hours

Unit -1: Basic concepts:
Statistical hypotheses- null and alternative, simple and Composite hypotheses. Type-I and Type-II Errors, Test function. Randomized and non randomized tests. Power function, size, power of the test and level of significance, critical region. P-value and its interpretation. Illustrative examples.  
09 hours

Unit-2: Tests of Significance:
18 hours

Unit-3: MP and UMP tests:
Most Powerful (MP) test. Statement of Neyman – Pearson Lemma and its applications. Monotone likelihood ratio (MLR) property. Uniformly most powerful (UMP) test. Statement of the theorem on UMP tests for testing one sided hypotheses for distributions with MLR property.  
11 hours

Unit-4 Non-Parametric tests:
Introduction to Non-Parametric tests. Run test for randomness. Sign test and Wilcoxon signed rank test for one and paired sample. Run test, median test and Mann-Whitney-Wilcoxon test for two sample problems. Test for independence based on Spearman's rank correlation coefficient.  
10 hours

Unit-5: Sequential tests: Need for sequential test, Wald's SPRT. Test for Bernoulli proportion & the mean of Normal population when variance is known under SPRT.  
04 hours

ST 402: Practical – IV - List of practicals  
(Demonstration of practicals using MS-Excel)
1. Evaluation of probabilities of Type-I and Type-II errors and power of tests.
2. Tests for mean, equality of means when variance is (i) known 
   (ii) unknown, under Normality (small and large samples)
3. Tests for single proportion and equality of two proportions.
4. Tests for variance and equality of two variances under normality
5. Tests for correlation coefficients and Regression coefficient.
6. Tests for independence of attributes and analysis of categorical data.
7. Tests for goodness of fit (uniform, Binomial, Poisson and Normal)
8. MP test for parameters of Binomial, Poisson distributions.
9. MP & UMP test for the mean of normal distribution and power curve.
10. Nonparametric tests-I (Test for randomness, sign tests)
11. Nonparametric tests-II. (Two sample tests)
12. SPRT for Bernoulli proportion & mean of normal distribution.
Text Books:

References:

B.Sc. Course in Statistics

Fifth Semester
3 hours lecture +3 hours practical per week
( Theory 2 credits + Practicals 1 credit)
ST 501: Applied Statistics -1


Unit -2 : Time Series Analysis:


Unit-4: Statistical Quality Control: Process control:
Derivation of control limits, basis, construction and interpretation of mean, range and standard deviation charts, np-chart, p-chart, stabilized p-chart, c-chart and u-chart. Criteria for detecting lack of control. Process Capability Study: Natural tolerance limits and specification limits, process capability, PCOR and interpretation.

Unit-5: Statistical Quality Control: Product control:

07 hours

ST 502 : Practical -V : List of practicals
5. Time series 2- Measurement of seasonal variation .
6 Construction of index numbers & Consumer Price Index numbers.
7. Tests for consistency of index numbers.
8. X - R charts. (Standard values known and unknown)
9. X - s charts. (Standard values known and unknown)
10. np and p charts. (Standard values known and unknown).
11. c and u charts. (Standard values known and unknown).
12. Drawing OC, AOQ, ASN, and ATI curves for single sampling plan.

Text Books:
4. Gupta,R.C: Statistical Quality control. (Khanna Pub., Co.)

References:
B.Sc. Course in Statistics
Fifth Semester
3 hours lecture + 3 hours practical per week
(Theory 2 credits + Practicals 1 credit)

ST 503: Design and Analysis of experiment

Unit-1 Analysis of variance:
Meaning and assumptions. Fixed, random & mixed effect models, Analysis of variance of one-way and two-way classified data with and without interaction effect. Multiple comparison tests-need. Tukey’s method.

Unit-2: Experimental designs:
Principles of design of experiments. Completely randomized, Randomized block and Latin square designs-layout formation and the analysis using fixed effect model. Cross-over design-analysis.

Unit-3: Efficiency of a design and Missing plot technique:
Comparison of efficiencies of CRD, RBD & LSD and Estimation of single missing observation in RBD and LSD and analysis.

Unit-4: Factorial experiment:
Factorial experiment- Basic concepts - Main effects and interactions and orthogonal contrasts in $2^2$ and $2^3$ factorial experiments. Yates’ method of computing factorial effects total. Analysis and testing the significance of effects in $2^2$ and $2^3$ factorial experiments (RBD).

Unit-5 Confounding:
Complete and partial confounding in a $2^3$ factorial experiment- layout and the analysis and testing the significance of effects (RBD). Comparison of unconfounded & confounded designs.

ST 504: Practical- VI:- List of practicals
1. ANOVA for one way classified data.
2. ANOVA for two way classified data.
3. ANOVA for two way classified data (With interaction)
4. Analysis of CRD,
5. Analysis of RBD and Missing plot technique.
6. Analysis of LSD and Missing plot technique.
7. Analysis of $2^2$ factorial experiment using RBD layout.
8. Analysis of $2^3$ factorial experiment using RBD layout.
9. Analysis of $2^3$ factorial experiment using RBD layout. (Complete confounding)
10. Analysis of $2^3$ factorial experiment using RBD layout. (Partial confounding)

Text Books:

References:
3. Veerarajan T: Probability , Statistics and Random process (Tata Mc Gran Hill)
B.Sc. Course in Statistics

Sixth Semester
4 hours lecture + 3 hours practical per week
(Theory 2 credits + Practicals 1 credit)

Unit-1: Reliability:

Unit-2: Psychological and Educational statistics:
Scaling of Mental tests and Psychological data. Scaling of scores on a test – Z-score, and scaling, standardized scores, normalized scores, computation of T-scores for a given frequency distribution, comparison of T-scores and standardized scores, percentile scores, scaling of rankings and ratings in terms of normal curves. Intelligent tests - intelligent quotient and educational quotient.

Unit-3 Clinical trails:

Unit-4: Demand analysis:

Unit-5: Official Statistics & National income:

ST 602: Practical – VII :- List of practicals
1. System Reliability Evaluation
2. Sketching Reliability and Hazard function.
3. Psychological and educational statistics-1 (Computation of various scores)
4. Psychological and educational statistics-2 (Scaling of ranking & ratings)
5. Clinical trials-1 (Odds ratio, relative risk, confidence interval)
6. Clinical trials-2 (ROC curve & computation of various rates,…)
7. Demand analysis-1 (Equilibrium & elasticity)
8. Demand analysis-2 (Utility analysis)
9. Demand analysis-3 (Fitting of Pareto curve & Lorenz curve)
Text Books:
   and Co.)
   Methods (PHI 2006)

References:
2. Veerarajan T: Probability, Statistics
   Govt. of India, New Delhi.
4. Saluja M. P ( ) Indian Official statistical Systems, Statistical Publishing Society,
   Calcutta.
7. Sen, A. (1997) : Poverty and Inequality

B.Sc. Course in Statistics
Sixth Semester
4 hours lecture +3 hours practical per week
(Theory 2 credits + Practicals 1 credit)
ST 603: Operations Research

Unit-1: Introduction to O.R and L.P.P:
Definition and scope of operations research (OR). Modeling and solution. Linear programming
problem (L.P.P) – Definition, Standard and canonical forms. Formulation of LPP. Basic solutions,
Degenerate and non degenerate solution. Graphical solution and Simplex algorithm for solving an
LPP. Artificial variable, ‘Charnes’ Big- M Method- Criteria for unbounded, multiple and infeasible
solutions.
Transportation problem: Mathematical formulation, Existence of feasible solution. Finding initial
basic feasible solution: North West corner rule, and Vogel’s method. Test for optimality. Transporta-
 tion algorithm. Problem of Degenerate solution. Unbalanced transportation problem
Assignment problem: Mathematical formulation and Hungarian algorithm. Unbalanced assignment
problem.

15 hours

Unit-2: Game theory:
Game theory-Basic concepts. Two-person zero sum game, Pure and mixed strategies. Maximin-
Minimax principle, Games with saddle point. Principle of dominance. Games without Saddle point-
mixed strategies, Determination of optimum solution for (2x2) game. Solution by graphical method for
(2xn) and (mx2) games.

05 hours

Unit-3: Inventory and Replacement Theory:
Description of an inventory system. Inventory costs. Demand, lead time and reorder level. Inventory
models. EOQ model with and without shortages.

Unit-4: Queuing theory:
Basic elements, description of a queuing system and measures of effectiveness. Statement of steady state solution of M/M/1 queuing system. Waiting time distributions. Little’s formula. Derivation of expressions for Queue length, and system size(length) and waiting times. Description of M/M/C queuing system.

Unit-5: PERT and CPM:
Basic elements of Network, Drawing of project network. Project planning with CPM and PERT. Critical path calculation. Critical path, slack time, floats. PERT three estimate approach. Calculation of probabilities of completing a Project within a specified period.

ST 604: Practical - VIII - List of practicals
(Demonstration of practicals using TORA Software.)
1. Formulation of Linear programming problem (L.P.P) - Graphical solution
2. Solution of L.P.P -- simplex algorithm-1
4. Transportation problem-1
5. Transportation problem-2
6. Assignment problem
7. Game problems.
8 Inventory problems
9. Replacement problems
10. Queuing Problems
11. PERT and CPM
12. Drawing random samples from discrete & continuous probability distributions.

Text Books:

References: