

**SOLAPUR UNIVERSITY, SOLAPUR.**



**SYLLABUS  
FOR  
Ph.D. Course Work  
IN  
STATISTICS**

**To be effective from the academic year 2014-15.**

## Syllabus for Ph.D. Course Work in Statistics

The following table gives the scheme of Theory Examination at Ph.D. Course Work in the subject Statistics.

<b>Paper No.</b>	<b>Title of the Paper</b>	<b>Marks</b>
<b>Paper-I</b>	<b>Research Methodology and Information Communication Technology</b>	<b>100</b>
<b>Paper-II</b>	<b>Modern Topics in Statistics</b>	<b>100</b>
<b>Paper-III</b>	<b>Advanced Development in Statistics (Elective)</b> <b>Elective-A. Industrial Statistics</b> <b>Elective-B. Sequential Analysis</b> <b>Elective-C. Applied Regression Analysis</b>	<b>100</b>

### **STATISTICS Paper-I**

**(Research Methodology and Information Communication Technology)**

**This paper is common to Faculty of Science.**

## **STATISTICS Paper-II**

### **(Modern Topics in Statistics)**

#### **Unit-1: Point Estimation**

Unbiasedness and consistency, Maximum likelihood estimation, Method of moment estimation, Goodness properties of estimators, Cramer-Rao inequality and efficiency of estimation.

#### **Unit-2: Data Reduction and Best Estimation**

Sufficiency, Minimal Sufficiency, Completeness, Ancillary Statistic, Basu's Theorem, UMVUE, Rao-Blackwell Theorem.

#### **Unit-3: Tests of Hypotheses**

Simple and Composite, Null and Alternative hypotheses, Tests, Errors of Type I and Type II, Power, Neyman Pearson lemma, its generalizations and uses, Likelihood Ratio Test (LRT) and Sequential LR Test (SPRT), The Chi-Square test of goodness of fit.

#### **Unit-4: Interval Estimation**

Confidence sets and Tests of hypotheses, Confidence intervals for one normal mean, Confidence intervals for one normal variance, Confidence intervals for a success probability, Confidence intervals for the difference of two normal means, Confidence intervals for the ratio of two normal variances, Large sample confidence intervals for difference of two probabilities of success.

**Unit-5:** Nonparametric method of estimation based on U-statistics, Sign, and Signed-Rank tests.

**Unit-6: Resampling Techniques:** Boot-strap and Jack-Knife, bootstrap variance estimation, bootstrap confidence interval and testing.

#### **Reference Books:**

- 1) Dudewicz and Mishra (1988): **Modern Mathematical Statistics**
- 2) Rohatgi and Saleh: **An Introduction to Probability and Statistics**, John Wiley and Sons.
- 3) B. K. Kale (1999): **Parametric Inference**, Narosa Publicaton.
- 4) George Casella and Roger L. Berger (1990): **Statistical Inference**, Cole Publishing Company.
- 5) Rao C.R. (1995): **Linear Statistical Inference and its Applications** (Wiley Estem Ltd.)
- 6) Efron B., and Tibshirani R.J. (1993), **An Introduction to the Bootstrap**, Chapman and Hall.

**STATISTICS (Paper-III )**  
**(Advanced Development in Statistics)**

**STATISTICS Paper-III (Elective-A)**

**Industrial Statistics**

**Unit-1.** Meaning and scope of SQC, A review of Shewhart control charts for  $\bar{X}$ , R, np, p, c etc. and their uses.

**Unit-2.** OC and ARL of control charts, use of runs and related pattern of points.

**Unit-3.** Control charts based on C.V., extreme values, moving averages, Modified control charts, CUSUM procedures, use of V-mask, derivation of ARL.

**Unit-4.** Process Capability, Tolerance limits, Beta content and beta expectation, normal theory and nonparametric approaches.

**Unit-5. Sampling Inspection Plans:** Classification and general properties, Sampling plans by variables, estimation of lot defective and plan parameter determination in known and unknown cases.

**Unit-6. Continuous sampling plans:** CSP-1 and its modifications, Derivation of AOQL for CSP-1. Operations of MLP's and Wald-Wolfowitz plans, MTL STD 105D and ISI plans.

**Reference Books:**

- 1). Montgomery D.C. (1996): Introduction to Statistical Quality Control.
- 2). Mitag H. and Rinne H. (1993): Statistical Methods in Quality Assurance.
- 3). Guenther W. 91981). Sampling inspection in Statistical Quality Control

## **STATISTICS Paper-III (Elective-B)**

### **Sequential Analysis**

**Unit-1:** Description of a decision problem, estimation, testing and confidence region procedures as special cases.

**Unit-2:** The concept of prior information, the posterior distribution, various kinds of priors, the families of conjugate priors.

**Unit-3:** Definition and need of sequential procedure, stein's two stage procedure.

**Unit-4:** Efficient sequential procedure for the parameters of binomial, multinomial Procedures.

**Unit-5:** Estimation of parameters and fixed width confidence interval.

**Unit-6:** Sequential test of hypothesis, tests for three hypothesis.

#### **Reference Books:**

- 1) De-Creet M.H. (1970): Optimal Statistical Decisions, Mac. Grew Hill.
- 2) Berger V.B. (1990): Statistical Decision Theory, Springer.
- 3) Ghosh B.K. (1970): Sequential tests of hypothesis
- 4) Govindrajulu, Z. (1961): Sequential Statistical Analysis, American Sciences Press, Columbus

## **STATISTICS Paper-III (Elective-C)**

### **Applied Regression Analysis**

- Unit-1.** Regression and Outliers: Introduction and review of basic results on regression. Drawing conclusions, interpreting estimates, case analysis, residuals and influences, symptoms and remedies.
- Unit-2.** Data analysis approach to residual analysis including Box-Cox transformation, Identification of outliers, identification of leverage points, Cook's method.
- Unit-3.** Regression and Collinearity: Tools for handling Multicollinearity, methods based on singular value decomposition and ridge regression, Properties of ridge estimator.
- Unit-4.** Robust Regression: Need for robust regression, M-estimators, Properties of robust estimators.
- Unit-5.** Logistic Regression Models: Model with a binary response variable, Estimation of parameters, Interpretation of parameters, Hypothesis tests on model parameters.
- Unit-6.** Introduction to General Nonlinear Regression: Least squares in non-linear case, estimating the parameters of a non-linear system, Reparametrisation of the model.

#### **Reference Books:**

- 1). Draper N. and Smith H. (1998): Applied Regression Analysis.
- 2). Gunst R. F. and Mason R. L. (1980): Regression Analysis and its Applications-A data oriented approach.
- 3). Montgomery D., Peck E. and Vining G. (2001): Introduction to Linear Regression Analysis.

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## Ph.D. Course Work Examination

### Nature of Question Paper

Total Marks:100

Time: Three Hours

- Q.1. a) Long answer type. (10 Marks)  
b) Short answer type / short note (Any Two) (10 Marks)  
(i)  
(ii)  
(iii)
- Q.2. a) Long answer type. (10 Marks)  
b) Short answer type / short note (Any Two) (10 Marks)  
(i)  
(ii)  
(iii)
- Q.3. a) Long answer type. (10 Marks)  
b) Short answer type / short note (Any Two) (10 Marks)  
(i)  
(ii)  
(iii)
- Q.4. a) Long answer type. (10 Marks)  
b) Short answer type / short note (Any Two) (10 Marks)  
(i)  
(ii)  
(iii)
- Q.5. a) Long answer type. (10 Marks)  
b) Short answer type / short note (Any Two) (10 Marks)  
(i)  
(ii)  
(iii)

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