St. Xavier’s College – Autonomous
Mumbai

T.Y.B.A

Syllabus
For 6th Semester Courses in
Statistics
(June 2016 onwards)

Contents:
Theory Syllabus for Courses:
A.STA.6.01 – Probability & Sampling Distributions (B).
A.STA.6.02 – Analysis of Variance & Design of Experiments.
A.STA.6.03 – Applied Statistics (B)

Practical Course Syllabus for: A.STA.6. PR
LEARNING OBJECTIVES:
1) To understand the patterns in the data of large populations.
2) To obtain data summarizing methods.
3) To know the relationship between various distributions.

Unit 1. **Transformation of random variables.** (15 lectures)
One-dimensional and two-dimensional continuous random variables. Jacobian of Transformation, Simple illustrations related to standard distributions

Unit 2. **Chi-Square Distribution:** (15 lectures)
Definition, its M.G.F., C.G.F, Moments, Mode, Derivation of distribution of Sum of Squares of standard normal variates, Additive property. Distributions of Sample Mean, Sample Variance and their independence for a sample drawn from Normal population. Asymptotic Property (without proof)
Applications of Chi-Square Distribution:
Test of significance for specified variance of Normal population.
Test for Goodness of Fit.

Unit 3. **t-distribution:** (15 lectures)
Applications of t-distribution:
Tests of significance for:
i) Single population mean
ii) Difference between two population means
   a) with equal variances based on independent samples.
   b) based on paired observations.
iii) Correlation coefficient (without proof).

**F-distribution:**

**Topics for practicals:**
- Normal Distribution.
- Chi-square distribution
- t – distribution
- F distribution.

**REFERENCE BOOKS**
LEARNING OBJECTIVES:
1) To introduce and apply the techniques and methodology available for designing and analysis of experiments.  
2) To emphasize the need for sound and unambiguous interpretation of experimentation.

Unit 1. Analysis of Variance (Fixed effect models) : (15 lectures)

One way classification (With equal and unequal observations per class)
Multiple comparisons of treatments
( i ) Least Significant difference test.. ( ii ) Tukey’s test. (iii) Dunnet’s test.
Two way classification (with one observation per cell)

Unit 2. Design of Experiments: ( 15 lectures)
Experiment, experimental unit, treatment, replicate, block, experimental error and precision.
Principles of design of experiment: Replication, Randomization and Local Control.
Choice of size, shape of plots and block in different agriculture and non-agriculture experiments.
Completely randomized design (CRD) & Randomized block design (RBD).
Mathematical model and its assumptions. Expectation of various sums of squares estimation of parameters by Least Squares Method. ANOVA table
Standard errors of treatment differences.
Efficiency of RBD over CRD.
Missing plot technique for one observation in RBD.

Unit 3. Latin square design (LSD) (15 lectures)
Efficiency of CRD over RBD.
Missing plot technique for one observation in LSD.
Symmetrical Factorial Experiments:
Purpose and advantages.
$2^2,2^3$ experiments. Calculation of main and interactions effects.
Yates method.
Analysis of $2^2,2^3$ experiments
Concepts of Confounding in $2^3$ experiments.

Topics for Practicals
- One Way ANOVA / CRD.
- Two Way ANOVA / RBD.
- LSD.
- Missing Plot Technique.
- Factorial Experiment.

References
LEARNING OBJECTIVES:
1) To learn techniques of mathematical modelling
2) To study methods to solve the formulated problems.
3) To learn the applications of operations research in industry.

APPLIED STATISTICS – (STATISTICS) [45 LECTURES]

Unit 1. DECISION THEORY:
Decision making under uncertainty Laplace criterion, Maximax (Minimin) criterion, Maximin
(Minimax) criterion, Hurwicz $\alpha$ criterion, Minimax Regret criterion.
Decision making under risk: Expected Monetary value criterion, Expected Opportunity Loss
Criterion, EPPI, EVPI Decision tree analysis.

GAME THEORY:
Definitions of Two person Zero Sum Game, Saddle Point, Value of the Game, Pure and Mixed
strategy.
Optimal solution of two person zero sum games: Dominance property,
Derivation of formulae for (2 x 2) game. Graphical solution of (2 x n ) and
(m x 2) games.

Unit 2. SIMULATION:
Scope of simulation applications. Types of simulation. Monte Carlo Technique of Simulation.
Elements of discrete event simulation. Generation of random numbers. Sampling from
probability distribution. Inverse method. Generation of random observations from i) Uniform
distribution ii) Exponential distribution iii) Gamma distribution iv) Normal distribution.
Simulation techniques applied to inventory and Queueing models.

Unit 3. MULTIPLE LINEAR REGRESSION:
Multiple linear regression model with two independent variables: Assumptions of the model,
Derivation of ordinary least square (OLS) estimators of regression coefficients, Properties of
least square estimators (without proof) Concept of $R^2$ and adjusted $R^2$. Procedure of testing
i) overall significance of the model ii) significance of individual coefficients iii) significance of
contribution of additional independent variable to a model. Confidence intervals for the
regression coefficients. Concept of Autocorrelation, Heteroscedasticity , Multicollinearity.

Topics for practicals:
- Decision Theory.
- Game theory.
- Simulation.
- Time Series.
- Multiple Linear regression.

References
   Chand & Sons.