**PUNYASHLOKAHILYADEVIHOLKAR SOLAPUR UNIVERSITY, SOLAPUR**



**Name of the Faculty: Commerce and Management**

# Syllabus

# M.Com. Advanced Statistics
# Part-I and Part-II

## As per NEP-2020

**To be implemented from Academic Year 2023-24**

**PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY**
**M.Com. Advanced Statistics Program Structure as perNEP-2020**

M.Com. (Advanced Statistics) consists of 88 credits. Credit so far course are specified against the title of the course.

| CourseType | Coursecode | Course Title | No. of Credits |
|---|---|---|---|
| **M.Com. Advanced Statistics Semester-I** | | | |
| Major Mandatory | DSC-1 | Matrix Algebra | 4 |
| | DSC-2 | Sampling Techniques | 4 |
| | DSC-3 | Operations Research-I | 4 |
| | DSC-4 | Demography | 2 |
| Major Elective | DSE-1 | Index Numbers | 4 |
| Research Methodology | RM | Research Methodology | 4 |
| **M.Com. Advanced Statistics Semester-II** | | | |
| CourseType | Coursecode | Course Title | No. of Credits |
| Major Mandatory | DSC-5 | OperationsResearch-II | 4 |
| | DSC-6 | InventoryManagement | 4 |
| | DSC-7 | Designof Experiments-I | 4 |
| | DSC-8 | Distribution Theory | 2 |
| Major Elective | DSE-2 | BasicExcel | 4 |
| On JobTraining | OJT | On JobTraining | 4 |
| **M.Com. Advanced Statistics Semester-III** | | | |
| CourseType | Coursecode | Course Title | No. of Credits |
| Major Mandatory | DSC-9 | Estimation Theory | 4 |
| | DSC-10 | Industrial Statistics-I | 4 |
| | DSC-11 | Designof Experiments-II | 4 |
| | DSC-12 | Time Series Analysis | 2 |
| Major Elective | DSE-3 | Advanced Excel | 4 |
| Research Project | RP | Research Project | 4 |
| **M.Com. Advanced Statistics Semester-IV** | | | |
| CourseType | Coursecode | Course Title | No. of Credits |
| Major Mandatory | DSC-13 | Testing of  Theory of Hypotheses | 4 |
| | DSC-14 | Industrial Statistics-II | 4 |
| | DSC-15 | Decision Theory | 4 |
| Research Project | RP | Research Project | 6 |
| Major Elective | DSE-4 | Introduction to SPSS | 4 |

## M.Com.-II Advanced Statistics Semester-III

| DSC-9 | Estimation Theory | No. of Credits: 04 |
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Course Outcomes:

Upon successful completion of this course, the student will be able to:

i) Explain the concepts of unbiasedness, sufficiency, efficiency and consistency.

ii) Obtain maximum likelihood estimator (MLE) and moment estimator of parameters.

Unit 1:
Notion of parameter, parameter space, general problem of estimation, estimating an unknown parameter by point estimation. Definition: Statistic, Estimator, Estimate. Distinction between estimator and estimate. Illustrative examples. Properties of estimator: Unbiasedness, consistency, efficiency and sufficiency. Unbiased estimator, biased estimator, positive and negative bias, examples of unbiased and biased estimators. **(15 L)**

Unit 2:
Consistency: Definition, proof of the following: (a) Sufficient condition for consistency, Illustrative examples. Relative efficiency of T1 with respect to T2, where T1 and T2 are unbiased estimators. Use of mean square error to modify the above definition for biased estimator. Illustrative examples. **(15 L)**

Unit 3:
Likelihood: Definition of likelihood function as a function of the parameter $\theta$ for a random sample from discrete and continuous distributions. Illustrative examples. Sufficiency: Concept of sufficiency, definition of sufficient statistic through (i) conditional distribution (ii) Neyman factorization criterion. Pitman Koopman form and sufficient statistic. Illustrative examples. **(15 L)**

Unit 4:
Method of maximum likelihood, derivation of maximum likelihood estimators for parameters of standard distributions. Illustrative examples. Method of moments: Derivation of moment estimators for standard distributions. Illustrative examples **(15 L)**

Reference Books:

1. Rohatgi, V.K. : Statistical Inference

2. Rohatgi, V.K. : An introduction to Probability Theory and Mathematical Statistics

3. Saxena H.C. and Surenderan: Statistical Inference

4. Kendal M.G. and Stuart A.: An advanced Theory of Statistics

5. Lehmann, E.L. : Theory of Point Estimation

| DSC-10 | Industrial Statistics -I | No. of Credits:04 |
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**Course Outcomes**: Upon successful completion of this course, the student will be able to:

i. Apply various basic quality control and improvement tools.

ii. Design and implement variable control charts.

iii. Design and implement attribute control charts.

iv. Design and implement sampling inspection plans.

**Unit 1:**

Meaning and purpose of Statistical Quality Control (SQC), Chance and assignable causes of variation, Process control and product control, Construction and working of Shewhart control chart, Statistical basis of 3σ control limits of, Lack of control situations, Natural tolerance limits and specification limits. Control charts for variables: Control chart for mean (X chart) and range (R chart), Derivation of control limits for X and R charts when standards are given and standards are not given, Numerical examples.                    (15 L)

**Unit 2:**

Control charts for attributes: Defect, defective and fraction defective, Control chart for number of defectives (d or np chart), derivation of control limits when standards are given and standards are not given. Control chart for fraction defectives (p chart) for variable and fixed sample size, derivation of control limits when standards are given and standards are not given. Control chart for number of defects per unit (C chart), situation where C chart is useful, derivation of control limits when standards are given and standards are not given. Numerical examples based on np, p and C charts.                    (15 L)

**Unit 3:**

Concept of Sampling Inspection Plan. Comparison of 100% inspection and sampling inspection. Consumer's risk, Producer's risk, Acceptable Quality Level (AQL), Lot Tolerance Percent Defective (LTPD), Average Outgoing Quality(AOQ), Average Outgoing Quality Limit (AOQL), Average Sample Number (ASN), Average Total Inspection (ATI) and Operative characteristic (OC) curve, Interpretation of AOQ, ASN and OC curves.                    (15L)

**Unit 4:**

Acceptance sampling plans for attributes, single, double and sequential sampling plans for attributes, concept and working, construction of AOQ, OC and ASN curves for single sampling plan. Acceptance sampling plans for variables for one sided specification.                    (15 L)

**Suggested Books:**

1. Statistical Quality Control, Grant E. L.

2.  Quality Control and Industrial Statistics, Duncan A. J.

3.  Fundamental of Applied Statistics, Gupta S. C. and Kapoor V. K.

4.  Introduction to Statistical Quality Control, Montgomery D. C.

| DSC-11 | Design of Experiment -II | No.ofCredits:04 |
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**Course Outcomes**: Upon successful completion of this course, the student will be able to:

  i. Understand the Efficiency of design.

  ii. Understand how to perform ANOCOVA.

 iii. Understand Factorial experiments and confounding.

**Unit 1:**
Efficiency of design, Concept and definition of efficiency of a design, Efficiency of RBD over CRD, Efficiency of LSD over CRD and LSD over RBD. Illustrative examples,
Analysis of Covariance (ANOCOVA) with one concomitant variable, Purpose of analysis of covariance, Practical situations where analysis of covariance is applicable, Model for analysis of covariance in CRD and RBD. Estimation of parameters (derivations are not expected). **(15 L)**

**Unit 2:**
General description of factorial experiments, $2^2$ and $2^3$ factorial experiments arranged in RBD. Definitions of main effects and interaction effects in $2^2$ and $2^3$ factorialexperiments. Model, assumptions and its interpretation.Preparation of ANOVA table by Yate's procedure, test for main effects and interaction effects.**(15 L)**

**Unit3:**
 General idea and purpose of confounding in factorial experiments. Total confounding (Confounding only one interaction) : ANOVA table, testing main effects and interaction effects. Illustrative examples. **(15 L)**

**Unit4:**
Partial Confounding (Confounding only one interaction per replicate): ANOVAtable, testing main effects and interaction effects. Construction of layout in total confounding and partial confounding in $2^3$ factorial experiments.Illustrative examples **(15 L)**

 **Suggested Books:**

1.  Montgomery, D.C.: Design and Analysis of Experiments, Wiley Eastern Ltd., New Delhi.

2.  Das, M.N. and Giri, N.C. : Design and Analysis of Experiments, Wiley Eastern Ltd., New Delhi

3.  Goon, Gupta, Dasgupta : Fundamental of Statistics, Vol. I and II, The World

Press Pvt. Ltd. Kolkata.

4. Gupta, S.C. and Kapoor, V.K. : Fundamentals of Applied Statistics, S. Chand & Sons, New Delhi.

| DSC-12 | Time Series Analysis | No. of Credits:02 |
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**Course Outcomes**: Upon successful completion of this course, the student will be able to:

i. Understand the fundamental of time series.

ii. Utilize Methods for Measuring Secular Trends.

iii. Utilize Methods for Measuring Seasonal variations.

**Unit 1:**
Introduction, Definition of Time Series, Role of time series analysis, Components of time series, Analysis of time series, Mathematical models for time series, Introduction of forecasting, Steps in forecasting, Requirement of good forecasting system, Methods of forecasting, **Methods for Measuring secular trends**: i) Freehand or Graphical method ii) Semi-average method iii) Methods of Moving Averages iv) Method of Least Squares (only for straight line), Merits and Demerits, Illustrative examples.    **(15 L)**

**Unit 2:**
**Methods for Measuring Seasonal Variations:**  i) Method of Simple Averages ii) Ratio to trend method iii) Ratio to Moving Average Method iv) Method to link relatives. Measurement of Cyclic variations, Measurement of Irregular variations. Merits and Demerits, Illustrative examples.                                        **(15 L)**

**Suggested Books:**
1. Fundamentals of Mathematical Statistics- S. C. Gupta and V.K. Kapoor
2. Fundamentals of Applied Statistics- S. C. Gupta and V.K. Kapoor
3. Business Statistics- J.K.Sharma
4. Business Statistics- S. P. Gupta and M. P. Gupta.

| DSE-3 | Advanced Excel | No. of Credits:04 |
|---|---|---|

**Course Outcomes**: Upon successful completion of this course, the student will be able to:

i. Cultivate Critical Thinking and Problem-Solving Abilities Using Excel.

ii. Develop Proficiency in Data Management and Analysis using Excel.

iii. Enhance Data Visualization and Reporting Skills.

iv. Apply Advanced Statistical Models for Business.

**Unit 1. Introduction to Excel for Statistical Analysis:**
Overview of Excel capabilities for statistical purposes, Familiarization with the Excel interface and toolbars for data analysis, Importing and exporting data for statistical analysis. **Data Management Techniques:** Data entry, formatting, and cleaning for statistical analysis. Sorting, filtering, and organizing large data sets. Using data validation for controlled data entry. Managing and structuring data tables.      (15 L)

**Unit 2. Descriptive Statistics using Excel:**
i) Calculating measures of central tendency: AVERAGE, MEDIAN, MODE ii) Calculating measures of dispersion: VAR, STDEV, STDEVP, QUARTILE iii) Using FREQUENCY and COUNTIF for distribution analysis iv) Creating histograms for data visualization. **Data Visualization:** Creating and interpreting charts: histograms, scatter plots, box plots. Customizing chart elements for clear data presentation. Advanced visualizations: pivot charts and combination charts. Using sparklines for visual data trends.                                                    (15 L)

**Unit 3. Probability and Statistical Distributions using Excel:**
Generating random numbers and simulating data sets. Applying probability functions: BINOM.DIST, POISSON.DIST, NORM.DIST. Using RAND and RANDBETWEEN for simulation purposes. Visualizing distributions with Excel tools. **Inferential Statistics:** i) Hypothesis testing basics: T.TEST, Z.TEST ii) Conducting one-sample and two-sample t-tests iii) Understanding and applying ANOVA (Analysis of Variance) iv) Using Excel's Data Analysis ToolPak for statistical tests.          (15 L)

**Unit 4.  Correlation Analysis and Time Series Analysis in Excel:**
Calculating and interpreting correlation coefficients with CORREL. Creating scatter plots for correlation visualization. Using COVARIANCE for covariance analysis. Understanding the limitations and assumptions of correlation. Importing and structuring time series data. Plotting time series data and identifying trends. Applying moving averages for smoothing data. Seasonal decomposition and trend analysis.                                                    (15 L)

**Suggested Books:**
1. "Business Analytics with Microsoft Excel" by M. P. Gupta
2. "Excel Data Analysis: Modeling and Simulation" by Hector Guerrero
3. "Statistical Methods for Business and Economics" by M. S. Narayana

4. "Statistical Analysis with Excel For Dummies" by Joseph Schmuller
5. "Data Analysis and Business Modeling Using Excel" by S. K. Gupta