SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A' Grade

Revised Syllabus For

BA Part-II

STATISTICS

CBCS PATTERN

Syllabus to be implemented from

June, 2019 onwards.

SHIVAJI UNIVERSITY, KOLHAPUR
SYLLABUS (SEMESTER PATTERN) (CBCS)
FOR B.A. II: STATISTICS

1. TITLE : B.A. Part II (Statistics)

   Under Faculty of Science.

2. YEAR OF IMEPLENTATION : Syllabus (Semester Pattern) will be Implemented from June 2019 & onwards.

3. DURATION : B.A. II-Two Semester (One year)

4. PATTERN OF EXAMINATION : Semester (CBCS Pattern), Practical- Internal Examination for each Semester.

   A) Theory Examination : At the end of each Semester Theory Examination of two hours and of 40 marks will be conducted for each paper as per Shivaji University Rule

   B) Practical Examination : At the end of each Semester, an Internal Practical Examination of one & half hours duration and of 10 marks will be conducted for each paper.

5. MEDIUM OF INSTRUCTION : English

6. STRUCTURE OF COURSE : B.A. II, Two Semesters, Four papers (Two Papers per Semester)

CHOICE BASED CREDIT SYSTEM IN B.A. II STATISTICS.
Structure

B .A. Part II

Sr. No.	Semester	Paper No.	Name of the Subject	Distribution of Marks		
				Theory	Practical	Total
1	III	III	Descriptive Statistics – II –DSE (Discipline Specific Elective)	40	10	50
2	III	IV	Discrete Probability Distributions-DSE (Discipline Specific Elective)	40	10	50
3	IV	V	Continuous Probability Distributions-DSE (Discipline Specific Elective)	40	10	50
4	IV	VI	Statistical Methods-DSE (Discipline Specific Elective)	40	10	50

7. SCHEME OF TEACHING:

Sr. No.	Semester	Paper No.	Name of the Paper	Teaching Scheme		
				Theory Lectures/ week	Practical Lectures/ week	Total
1	III	III	Descriptive Statistics – II -DSE (Discipline Specific Elective)	3	1	4
2	III	IV	Discrete Probability Distributions-DSE (Discipline Specific Elective)	3	1	4
3	IV	V	Continuous Probability Distributions-DSE (Discipline Specific Elective)	3	1	4
4	IV	VI	Statistical Methods-DSE (Discipline Specific Elective)	3	1	4

8. SCHEME OF EXAMINATION:

- The examination shall be at the end of each semester.
- All papers shall carry 40 marks for Theory and 10 marks for practical.
- The evaluation of the performance of the students in theory shall be on the basis of semester examination as mentioned above.
- Question paper will be set in the view of the entire syllabus preferably covering each unit of the syllabus. In theory examination weightage to numerical problems should not exceed 40%.
- Use of calculators is allowed for both theory and practical examinations.

- **Nature of question paper (Theory)**
  - There will be five objective type question having one mark each.
  - Short answer type questions having 15 marks (Three out of five each of five marks).
  - Long answer questions having 20 marks (Two out of Three, each of ten marks).

- **Nature of question paper (Practical)**
  - Practical Examination will be conducted separately for each paper for 10 marks of one and half hour duration.
  - There will be four questions of four marks each for each paper. Student has to attempt any two questions.
  - Two marks are reserved for journal.
  - A student must complete all practicals and he/she has to produce journal along with completion certificate at the time of practical examination. Duration of practical examination will be one and half hour for each paper.
- The evaluation of the performance of the students in practical shall be on the basis of internal evaluation at the end of **each semester**.

- **Standard of Passing:**

In order to pass, student shall have to secure 35% marks in each of theory and practical examination separately. [i.e. minimum 14 marks for theory & minimum 4 marks for practicals].

Equivalence of Papers

Old (Semester Pattern)		New (Semester Pattern)		
Paper No.	Title of the Paper	Paper No.	Semester	Title of the Paper
III	Descriptive Statistics – II	III	III	Descriptive Statistics – II -DSE (Discipline Specific Elective)
IV	Discrete Probability Distributions	IV	III	Discrete Probability Distributions-DSE (Discipline Specific Elective)
V	Standard Discrete Distributions	V	IV	Continuous Probability Distributions-DSE (Discipline Specific Elective)
VI	Continuous Probability Distributons	VI	IV	Statistical Methods-DSE (Discipline Specific Elective)

B. A. II: (STATISTICS) SEMESTER III

PAPER-III: DESCRIPTIVE STATISTICS –II DSE (Discipline Specific Elective)

Total Credits: 4 **(Theory:** 3 Credits and **Practical:** 1 Credit)

Total Workload: 4 **(Theory:** 3 Lectures per week and **Practical:** 1 Lecture per week).

OBJECTIVES:

The main objective of this course is to introduce to some elementary statistical methods of analysis of data and at the end of this course students are expected to be able,

1) to compute correlation coefficient, interpret its value and use in regression analysis
2) to understand concept of multivariate data analysis.

Unit1. Correlation: **(10)**

1.1. Bivariate Data. Concept of correlation between two variables, Types of correlation.
1.2. Scatter diagram, its utility.
1.3. Covariance: Definition, Karl Pearson's coefficient of correlation (r): Definition & Interpretation of r = – 1, 0, 1. Computation for ungrouped and grouped data, Properties: i) $-1 \leq r \leq 1$,
ii) Effect of change of origin and scale.
1.4. Spearman's rank correlation coefficient: Definition, Computation (for with and without ties). Derivation of the formula for without ties. Illustrative examples.

Unit2. Regression: **(10)**

2.1. Concept of regression, Lines of regression, Derivation of lines of regression by the least squares method.

2.2. Regression coefficients (b_{xy}, b_{yx}) and their geometric interpretations,
Properties: i)$b_{xy} \times b_{yx} = r^2$, ii) $b_{xy} \times b_{yx} \leq 1$, iii) $(b_{xy} + b_{yx})/2 \geq r$, iv)
Effect of change of origin and scale on regression coefficients, v) the point of intersection of two regression lines.
2.3. Derivation of acute angle between the two lines of regression.
2.4. Illustrative examples.

Unit3: Multiple Linear Regression (for trivariate data only): **(12)**

3.1. Concept of multiple linear regression, Yule's notation, correlation matrix.
3.2. Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation.
3.3. Residual: definition, order, properties, derivation of mean and variance of residuals.
3.4. Properties of Residual.

Unit4: Multiple and Partial Correlation (for trivariate data only): **(13)**

4.1. Concept of multiple correlations. Definition of multiple correlation coefficients $R_{i.jk}$, $i \neq j \neq k$, $i, j, k = 1, 2, 3$. Derivation of formula for multiple correlation coefficients.
4.2. Properties of multiple correlation coefficient; i) $0 \leq R_{i.jk} \leq 1$, (ii) $R_{i.jk} > |r_{ij}|$, (iii) $R_{i.jk} > |r_{ik}|$ $i = j = k = 1, 2, 3$. $i \neq j$, $i \neq k$. Interpretation of $R_{i.jk} = 1$, $R_{i.jk} = 0$.
4.3. Concept of partial correlation. Definition of partial correlation coefficient $r_{ij.k}$, derivation of formula for $r_{ij.k}$, $i \neq j \neq k$, $i, j, k = 1, 2, 3$.
4.4. Properties of partial correlation coefficient (i) $-1 \leq r_{ij.k} \leq 1$, (ii) $b_{ij.k}\, b_{ji.k} = r_{ij.k}^2$, where $b_{ij.k}$ is partial regression coefficient of X_i on X_j. Examples and problems.

Practical:

1. Computation of Karl Pearson's coefficient of correlation.
2. Computation of Spearman's rank coefficient of correlation.
3. Fitting of Lines of regression.
4. Fitting of Multiple linear regression.
5. Computation of multiple correlation coefficient and partial correlation coefficient.

Books Recommended:

1. Bhat B. R., Srivenkatramana T. and Madhava Rao K. S. :Statistics: A Beginner's Text, Vol. 1, New Age International (P) Ltd.
2. Croxton F. E., Cowden D.J. and Kelin S. : Applied General Statistics, Prentice Hall of India.
3. Goon A.M., Gupta M.K., and Dasgupta B.: Fundamentals of Statistics Vol. I and II, World Press, Calcutta.
4. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
5. Snedecor G.W. and Cochran W. G. : Statistical Methods, Iowa State University Press.
6. Waiker and Lev.: Elementary Statistical Methods.
7. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics.- Sultan & Chand

Semester III, Paper IV
Discrete Probability Distributions - DSE(Discipline Specific Elective)

Total Credits: 4 (Theory: 3 Credits and **Practical:** 1Credit)

Total Workload: 4 (Theory: 3 Lectures per week and **Practical:** 1 Lecture per week).

OBJECTIVES:

The main objective of this course is to acquaint students with some basic concepts of probability, concept of random variable, probability distribution (univariate). By the end of this course students are expected to be able to,

(1) find various measures of r.v. using its probability distribution.
(2) understand concept of bivariate discrete distributions and computation of related probabilities.
(3) study some standard discrete probability distributions.

Unit – 1: Univariate Discrete Random Variable : (10)

1.1. Sample Space (finite and countablyinfinite), Definition of discrete random variable (r.v.). Probability Mass Function (p.m.f.) and Cumulative Distribution Function (c.d.f.) of discrete random variable. Properties of c.d.f. (statements only), illustrative examples.
1.2. Median and mode of a univariate discrete random variable.
1.3. Definition of expectation of a function of a random variable. Definition of mean and variance of distribution. Properties: (i) $E(c) = c$, where c is constant (ii) $E(aX + b) = a\,E(X) + b$, where a and b are constants. (iii) $V(aX+b) = a^2\,V(X)$.
1.4. Definition of p.g.f. of r.v. X. p.g.f. of (i) X+c (ii) aX +b where a, b and c are constants. Mean and variance using p.g.f., Examples.

Unit – 2: Bivariate Discrete Random Variable: (13)

2.1. Definition of bivariate random variable (X, Y) on finite sample space, joint p.m.f. and joint c.d.f., properties of c.d.f. (statements only), verification by numerical problems. Computation of probabilities of events in bivariate probability distribution.
2.2. Concept of marginal and conditional probability distributions, independence of two discrete random variables.
2.3. Definition of expectation of a function of bivariate r.v., Theorem on expectations, (i) $E(X + Y) = E(X) + E(Y)$ (ii) $E(XY) = E(X)\,E(Y)$ when X and Y are independent . Expectation and variance of linear combination of two discrete random variables.
2.4. Definition of conditional mean, conditional variance, covariance and correlation coefficient. Expression for $Cov(aX + bY, cX + dY)$ where a, b, c and d are constants. Distinction between uncorrelated and independent variables, Examples.

Unit – 3: Discrete Probability Distributions on finite range: (12)

3.1. Idea of one point and two point distributions, p.m.f., mean, variance, p.g.f., of each of them. Bernoulli distribution: p.m.f., mean, variance, p.g.f., mean and variance from p.g.f. .
3.2. Discrete uniform distribution: p.m.f., mean, variance, p.g.f.
3.3. Binomial distribution: Binomial random variable, p.m.f. with parameters (n, p), mean, variance, p.g.f., mean and variance from p.g.f., recurrence relation for successive probabilities, distribution of sum of independent and identically distributed Bernoulli variables, additive property.
3.4. Hypergeometric distribution: p.m.f. with parameters (N, M, n), mean and variance of distribution assuming $n \leq \min\{M, N - M\}$, recurrence relation for successive probabilities. Binomial distribution as a limiting case of hypergeometric distribution (statement only).

Unit – 4: Discrete Probability Distributions on countable infinite range: (10)

4.1. Poisson distribution: p.m.f. with parameter λ, mean, variance, p.g.f., mean and variance from p.g.f., recurrence relation for successive probabilities, additive property of Poisson distribution. Poisson distribution as a limiting case of binomial distribution (statement only).
4.2. Geometric distribution: p.m.f. with parameter p, mean, variance, distribution function, p.g.f., mean and variance fromp.g.f., lack of memory property, recurrence relation for successive probabilities.
4.3. Negative binomial distribution: p.m.f. with parameters (k, p), geometric distribution as a particular case of Negative binomial distribution, p.g.f., recurrence relation for successive probabilities.
4.4. Examples and problems.

Practical:

1. Applications of Binomial and Hypergeometric distributions.
2. Applications of Poisson distribution.
3. Applications of Geometric distribution.
4. Applications of Negative-Binomial distribution.
5. Applications of Bivariate Discrete distribution.

Books Recommended :

1. Gupta V. K. and Kapoor S.C. : Fundamentals of Mathematical Statistics, Sultan and Chand.
2. Agarwal B. L. : Basic Statistics, New age International (P) Ltd.
3. Goon A. M. ,Gupta M.K. and Dasgupta B. : Fundamentals of Statistics, Vol.-I and II, World PressCulcutta.
4. ParimalMukhopadhayaya: An Introduction to the theory of probability, World Scientific.
5. Hogg R. V. and Craig, A. T. : An Introduction to Fundamentals of Mathematical Statistics, McMillan Publication, New York.
6. Trivedi R. S. : Probability and Statistics with Reliability and computer Science Applications, Prentice – Hall of India, Pvt. Ltd, New Delhi.

Semester IV, Paper V
Continuous Probability Distributions – DSE (Discipline Specific Elective)

Total Credits: 4 (Theory: 3 Credits and **Practical:** 1Credit)

Total Workload: 4 (Theory: 3 Lectures per week and **Practical:** 1 Lecture per week).

OBJECTIVES:

The main objective of this course is;
1) to introduce concept of continuous univariate and bivariate distribution and their properties.
2) to introduce some standard continuous distribution with their properties and applications.
At the end of course students are expected to understand concept of continuous distribution and their applications in real life.

Unit 1: Continuous Univariate Distributions: (12)

1.1. Definition of the continuous sample space with illustrations, definition of continuous random variable (r.v.), probability density function (p.d.f.), cumulative distribution function (c.d.f.) and its properties. Expectation of r.v., expectation of function of r.v., mean, median, mode, quartiles, variance, harmonic mean, raw and central moments.
1.2. Moments generating function (m.g.f.): definition and properties
(i) Standardization property $M_X(0) = 1$, (ii) Effect of change of origin and scale,
(iii) Uniqueness property of m.g.f., if exists, (statement only). Generation of raw and central moments using m.g.f.
1.3. Cumulant generating function (c.g.f.): definition, relations between cumulants and central moments (up to order four).
1.4. Transformation of univariate continuous r.v.: Distribution of Y=g(X), where g is monotonic or non-monotonic functions using (i) Jacobian of transformation, (ii) distribution function.

Unit 2: Continuous Bivariate Distributions: (13)

2.1. Definition of bivariate continuous random variable(X, Y), Joint p. d. f., c. d. f with properties, marginal and conditional distribution, independence of random variables.
2.2. Expectation of function of r. v. s means, variances, covariance, correlation coefficient, conditional expectation, regression as conditional expectation if it is linear function of other variable and conditional variance, proof of
i) $E(X \pm Y) = E(X) \pm E(Y)$, ii) $E[E(X/Y)] = E(X)$.
2.3. If X and Y are independent r.v.s. then
(i) $E(XY) = E(X)\,E(Y)$, (ii) $M_{x+y}(t) = M_x(t)\,M_y(t)$ with proof.
2.4. Transformation of continuous bivariate r.v.s : Distribution of bivariate r.v.s. using Jacobean of transformation.

Unit 3: Uniform, Exponential and Gamma distribution: (09)

3.1. Uniform distribution: Definition of Uniform distribution over (a, b), c.d.f., m.g.f., mean, variance, moments. Distribution of (i) (X-a) / (b-a), (ii) (b-X) / (b-a), (iii) Y = F(x) where F(x) is c.d.f. of any continuous r.v..
3.2: Exponential distribution: p.d.f. (one parameter) c.d.f., m.g.f., c.g.f., mean, variance, C.V., moments, Cumulants, median, lack of memory property.
3.3. Gamma distribution: Gamma distribution: Gamma distribution with scale parameter θ and shape parameter n,special case $\theta = 1$, $n = 1$, m.g.f., c.g.f., mean, mode, variance, moments, cumulants, $\beta_1, \beta_2, \gamma_1$ and γ_2 coefficients, additive property: distribution of sum of i.i.d. exponential variates.
3.4. Examples and problems.

Unit 4: Normal, Chi-square and t- distributions: (11)

4.1. Normal Distribution:Normal distribution with parameters μ & σ^2, Definition of standard normal distribution, properties of normal curve, m.g.f., c.g.f., mean, variance, median, mode.
4.2. Chi-square Distribution: Chi-Square distribution: Definition of chi square, mean, variance, moments, mode, additive property.
4.3. Student's t- distribution: Definition of student's t variate. Mean, mode, variance, moments, $\beta_1, \beta_2, \gamma_1$ and γ_2 coefficients.
4.4. Examples and Problems.

Practical:

1. Applications of Normal distribution.
2. Applications of uniform distribution.
3. Applications of exponential distribution.

4. Continuous bivariate distribution: Conditional and marginal distributions; their means and variances. Independence of random variables.
5. Problems on Transformation of univariate continuous r.v..

Books Recommended:

1. Trivedi R. S.: Probability and Statistics with Reliability and Computer Science Application, Prentice – Hall of India Pvt. Ltd., New Delhi.
2. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics. Macmillan Publishing, New York.
3. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi
4. Mood A.M., Graybill F.A., Boes D.C.: Introduction to theory of Statistics. Tata McGraw Hill, New Delhi. (Third Edition)
5. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics, Vol. I and II, World Press,
6. Waikar and Lev: Elementary Statistical Methods.

Semester IV, Paper VI
Statistical Methods – DSE (Discipline Specific Elective)

Total Credits: 4 (Theory: 3 Credits and **Practical:** 1Credit)

Total Workload: 4 (Theory: 3 Lectures per week and **Practical:** 1 Lecture per week).

OBJECTIVES:

At the end of course students are expected to
(1) understand concept of time series, index numbers.
(2) computation of secular trend, seasonal index, index numbers and their applications in real life.
(3) apply statistical tests to test various population parameters and
(4) construction of Shewhart's elementary control charts for variables and attributes.

Unit 1: Time Series: (08)

1.1. Meaning and need of time series analysis. Components of time series
(i) Secular trend (ii) Seasonal Variation (iii) Cyclical Variation (iv) Irregular Variation.
1.2. Measurement of trend: (i) Moving averages method (ii) Progressive average method
1.3. Measurement of seasonal indices by simple average method.
1.4. Examples.

Unit-2: Index Numbers: (12)

2.1. Meaning and utility of index numbers,
2.2. Problems in construction of index numbers.
2.3. Unweighted index numbers using (i) aggregate method (ii) average of price or quantity relative method (A.M. is to be used as an average).
2.4. Weighted index numbers Index numbers using; Laspeyre's, Paasche's and Fisher's formula.

Unit-3: Testing of Hypothesis: (12)

3.1. Notion of Population, Sample, Parameter, Statistic, Sampling distribution of Statistic, hypothesis, Simple and composite hypothesis, Null and alternative hypothesis, type I and type II errors, Critical region, level of significance, one and two tailed test.
3.2. Large Sample Tests: General procedure of testing of hypothesis.
Tests for means: i) testing of single population mean; H_0: $\mu = \mu_0$

ii) testing equality of two population means; H_0: $\mu_1 = \mu_2$

3.3. Small Sample Tests:

t- test: a) test for means: i) H_0: $\mu = \mu_0$,

ii) H_0: $\mu_1 = \mu_2$, ($\sigma_1 = \sigma_2$)

iii) Paired t- test

3.4. Chi-square – test: i) test for goodness of fit ii) test for independence of attributes.

Unit-4: Statistical Quality Control: (13)

4.1. Meaning and purpose of S.Q.C., Process control, Product control, Chance causes, Assignable causes,

4.2. Shewhart's control chart- construction & working.

4.3. Control charts for variables - control chart for mean, control chart for range, construction and working of mean & range charts for unknown standards.

4.4. Control charts for Attributes – Defects, defectives, control chart for number of defectives (np-chart) for fixed sample size and unknown standards, construction of the chart. Control charts for number of defects (C-chart), for unknown standards, construction of C-chart.

Practical:

1. Time Series. (Progressive averages, Moving average & Seasonal Index by Simple average methods.)
2. Index Numbers. (computations of index numbers)
3. Large sample tests for means.
4. Tests based on Chi square distribution.(Tests for independence, Test for goodness of fit.)
5. Tests based on t distribution ($\mu = \mu_0$, $\mu_1 = \mu_2$; paired t test).
6. Construction of Range, Mean, np and C charts.

Books Recommended:

1. Trivedi R. S.: Probability and Statistics with Reliability and Computer Science Application, Prentice – Hall of India Pvt. Ltd., New Delhi.
2. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics. Macmillan Publishing, New York.
3. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi
4. Mood A.M., Graybill F.A., Boes D.C.: Introduction to theory of Statistics. Tata McGraw Hill, New Delhi. (Third Edition)
5. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics, Vol. I and II, World Press,
6. Waikar and Lev: Elementary Statistical Methods.
7. Pal Nabendu and Sarkar Sahadeb: Statistics : Concept and Applications, Prentice Hall, India

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