SHIVAJI UNIVERSITY, KOLHAPUR

SYLLABUS (SEMESTER PATTERN) 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 2015 & onwards.
3.	DURATION	: B.A. II-Two Semester (one year)
4.	PATTERN OF EXAMINATION	: Semester Practical-Internal Examination
5.	MEDIUM OF INSTRUCTION	: English
6.	STRUCTURE OF COURSE	: B.A. II Two Semesters Four Papers

Sr. No.	Semester	Paper No.	Name of Subject	Distribution of Marks		
				Theory	Practical	Total
1	III	III	Descriptive Statistics-II	40	10	50
2	III	IV	Discrete Probability Distributions	40	10	50
3	IV	V	Standard Discrete Distributions	40	10	50
4	IV	VI	Continuous Probability Distributions-I	40	10	50

7. SCHEME OF TEACHING:

Sr. No.	Semester	Paper No.	Name of Subject	Distribution of Marks		
				Theory: Lectures/ Week	Practical: Lectures/ Week	Total
1	III	III	Discriptive Statistics-II	3	1	4
2	III	IV	Discrete Probability Distributions	3	1	4
3	IV	V	Standard Discrete Distributions	3	1	4
4	IV	VI	Continuous Probability Distributions-I	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 one objective type question consisting of 5 multiple choice questions one mark each.
  - Short answer type questions having 15 marks (Three out of five of five marks each).
  - Long answer questions having 20 marks (Two out of Three of ten marks each).
- Nature of question paper (Practical)
  - There will be four questions of four marks each. Student has to attend any two questions.
  - Two marks are reserved to 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.

- The evaluation of the performance of the students in practical shall be done by the university by appointing one internal and one external examiner 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.

Semester III, Paper-III
Descriptive Statistics-II

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.

Unit-1. Correlation: (10)

1.1 Bivariate Data.

1.2 Concept of correlation between two variables, Types of correlation.

1.3 Scatter diagram, its utility.

1.4 Covariance: Definition, Effect of change of origin and scale.

1.5 Karl Pearson's coefficient of correlation (r): Definition, Computation for ungrouped and grouped data,

1.6 Properties:i) $-1 \leq r \leq 1$, ii) Effect of change of origin and scale.(iii) Interpretation when $r = -1, 0, 1$.

1.7 Spearman's rank correlation coefficient: Definition, Computation (for with and without ties). Derivation of the formula for without ties and modification of the formula for with ties.

1.8 Illustrative examples.

Unit-2. Regression: (10)

2.1Concept of regression, Lines of regression, fitting 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.

Unit-3: Multiple Linear Regression (for trivariate data only): **(10)**

3.1 Concept of multiple linear regression, Plane of 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, Covariance between residuals.

Unit-4: Multiple and Partial Correlation (for trivariate data only): **(10)**

4.1 Concept of multiple correlations. Definition of multiple correlation coefficients$R_{i.jk}$, 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 ≠ j, i ≠ k.

4.3 Interpretation of $R_{i.jk}=1$, $R_{i.jk} = 0$, coefficient of determination $R^2_{i.jk.}$

4.4 Concept of partial correlation. Definition of partial correlation coefficient $r_{ij.k}$, derivation of formula for $r_{ij.k}$.

4.5 Properties of partial correlation coefficient (i) $-1 \leq r_{ij.k} \leq 1$, (ii) $b_{ij.k} b_{ji.k} = r^2_{ij.k.}$

4.6 Examples and problems.

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

Practicals:

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 and partial correlation coefficient

Semester III, Paper-IV
Discrete Probability Distributions

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,

(i) find various measures of r.v. using it's probability distribution.

(ii) understand concept of bivariate discrete distributions and computation of related probabilities.

Unit – 1 : UnivariateDiscrete Random Variable : (10)

1.1 Sample Space (finite and countablyinfinite), Definition of discrete random variable (r.v.).

1.2 Probability Mass Function (p.m.f.) and Cumulative Distribution Function (c.d.f.) ofdiscrete random variable.

1.3 Properties of c.d.f. (statements only), verification by numerical problems.

1.4 Probability distribution of random variable and computation probabilities of differentevents.

1.5 Median and mode of a univariate discrete random variable.

1.6 Examples

Unit – 2 : Mathematical Expectation (10)

2.1 Definition of expectation of random variable, expectation of a function of a randomvariable.

2.2 Rules of expectations,

(i) E(c) = c, where c is constant

(ii) E(aX + b) = a E(X) +b , where a and b are constants.

2.3 Definition of mean and variance of distribution, effect of change of origin and scaleon mean and variance.

2.4 Definition of raw and central moments, Pearson's coefficient of skewness and kurtosis.

2.5 Definition of m.g.f. and p.g.f. of r.v. X. m.g.f and p.g.f. of (i) X+c (ii) aX +b where a, b and c are constants.

2.6 To find mean and variance using m.g.f. and p.g.f.

2.7 Examples.

Unit – 3 :Bivariate Discrete Random Variable (10)

3.1 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.

3.2 Concept of marginal and conditional probability distributions, independents of two discrete random variables.

3.3 Examples

Unit – 4 **: Mathematical Expectation of Bivariate DiscreteRandom Variable**

(10)

4.1 Definition of expectation of a function of r.v.in bivariate distribution, Theorem on expectations, (i) $E(X + Y) = E(X) + E(Y)$ (ii) $E(XY) = E(X) E(Y)$ when X and Y are independent .

4.2 Expectation and variance of linear combination of two discrete random variables.

4.3 Definition of conditional mean, conditional variance, covariance and correlation coefficient.

4.4 $Cov(aX + bY, cX + dY)$ where a, b, c and d are constants. Distinction between uncorrelated and independent variables.

4.5 m.g.f. of (i) (X, Y) (ii) X+Y (iii) m.g.f. of X and Y from that of (X, Y)

4.6 Examples

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
Standard Discrete Distributions

OBJECTIVES:

Main objective of this course is to study some standard discrete probability distributions. By the end of this course, students are expected to be able to know some standard discrete probability distributions with real life situations.

Unit-1. One point, two point, Bernoulli, uniform and binomial distributions. (13)

1.1. Idea of one point and two point distributions, p.m.f., mean, variance, p.g.f., m.g.f. of each of them.

1.2. Bernoulli distribution: p.m.f., mean, variance, p.g.f., m.g.f, mean and variance from p.g.f. and m.g.f.

1.3. Discrete uniform distribution: p.m.f., mean, variance, p.g.f. and m.g.f.

1.4. Binomial distribution: Binomial random variable, p.m.f. with parameters (n, p), mean, variance, m.g.f., p.g.f., mean and variance from m.g.f./p.g.f., recurrence relation for successive probabilities, distribution of sum of independent and identically distributed Bernoulli variables, additive property.

1.5. Examples and problems.

Unit-2.Hypergeometric and Poisson distributions. (11)

2.1. 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).

2.2. Poisson distribution: p.m.f. with parameter λ, mean, variance, m.g.f., p.g.f., mean and variance from m.g.f./p.g.f., recurrence relation for successive probabilities, additive property of Poisson distribution.Poisson distribution as a limiting case of binomial distribution (statement only).

2.3. Examples and problems.

Unit-3. Geometric and Negative binomial distribution (11)

3.1. Geometric distribution: p.m.f. with parameter p, mean, variance, distribution function, m.g.f., p.g.f., mean and variance from m.g.f./p.g.f., lack of memory property, recurrence relation for successive probabilities.Waiting time distribution, relation between geometric and waiting time distributions, mean and variance of waiting time distribution using the relation.

3.2. Negative binomial distribution: p.m.f. with parameters (k, p), geometric distribution as a particular case of Negative binomial distribution, Mean, variance, m.g.f., p.g.f., mean and variance from m.g.f./p.g.f., recurrence relation for successive probabilities.

3.3. Examples and problems.

Unit-4.Trinomial distribution. (10)

4.1. Definition, p.m.f. with parameters (n, p1, p2), m.g.f., means, variances and covariance using m.g.f., correlation coefficient. Distribution of X+Y using m.g.f., marginal and conditional distributions.

4.2. Generalization of Trinomial to Multinomial distribution. Statements of the marginal distribution of X_i, the Cov(X_i, X_j) and variance – covariance matrix.

4.3. Examples and problems.

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 Press Culcutta.
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.

Practicals:

1. Applications of binomial and hypergeometric distributions.
2. Applications of Poisson distribution.
3. Applications of geometric and negative binomial distributions.
4. Applications of trinomial distribution.
5. Model sampling from binomial and hypergeometric distributions.

Semester IV, Paper-VI
Continuous Probability Distribution-I

OBJECTIVES:

The main objective of this course is;

1) to introduce concept of continuous univariate and bivariate distribution and their properties.
2) to introduce uniform and exponential 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.

1.2: Expectation of r.v., expectation of function of r.v., mean, median, mode, quartiles,variance,harmonic mean, raw and central moments, skewness and kurtosis,examples

1.3: 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.

1.4 Cumulant generating function (c.g.f.): definition, relations between cumulants and central moments (up to order four).

1.5 Examples.

Unit-2: Continuous Bivariate Distributions: (15)

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, evaluation of probabilities of various regions bounded by straight lines.

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: Examples and problems.

Unit-3: Transformations of continuous r.v.: (08)

3.1: 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 and (iii) m.g.f. methods.

3.2: Transformation of continuous bivariate r.v.s : Distribution of bivariate r.v.s. using Jacobian of transformation.

3.3: Examples and problems.

Unit-4: Uniform and Exponential Distribution: (10)

4.1: 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., Examples and problems.

4.2: Exponential distribution: p.d.f. (one parameter) c.d.f., m.g.f., c.g.f., mean, variance, C.V., moments, Cumulants, median, quartiles, lack of memory property, distribution of – (1/ θ) logX, where X~U (0, 1), Examples and problems.

Books Recommended

1. Trivedi R. S.: Probability and Statistics with Reliability and Computer Science Application, Prentice – Hall of India Pvt. Ltd., New Delhi.
2. Parimal Mukhopadhayay: An Introduction to the Theory of ProbabilityWorld Scientific Publishing.
3. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics.Macmillan Publishing, New York.
4. Gupta S. C. &Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi
5. Mood A.M., Graybill F.A., Boes D.C.: Introduction to theory of Statistics. Tata McGraw Hill, New Delhi. (Third Edition)
6. Walpole R.E. & Mayer R.H.: Probability & StatisticsMacMillan Publishing Co. Inc,New York

7. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics,Vol.I and II, World Press,

8. Snedecor G.W. and Cochran W. G. Statistical Methods, Iowa State University Press.

9. Waikar and Lev: Elementary Statistical Methods.

Practical:

1. Model sampling from continuous distribution.
2. Model sampling from uniform distribution
3. Model sampling from exponential distribution
4. Applications of uniform and exponential distribution.
5. Application of bivariate distributions.