SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A' Grade

Revised Syllabus For

Bachelor of Science

Part-II

Statistics

CBCS PATTERN

Syllabus to be implemented from

June, 2019 onwards.

SHIVAJI UNIVERSITY, KOLHAPUR
CBCS SYLLABUS WITH EFFECT FROM JUNE, 2019
B. Sc. Part-II: SEMESTER III
SUBJECT: STATISTCS -V
DSC - 7C: Probability Distributions–I
Theory: 36 Hrs. Marks-50 (Credit 2)

OBJECTIVES:

The main objective of this course is to acquaint students with the basic concepts of discrete distributions defined on countably infinite sample space, continuous univariate and bivariate distributions, transformation of univariate continuous random variable.

By the end of the course students are expected to be able to:

a) understand concept of discrete and continuous probability distributions with real life situations.
b) distinguish between discrete and continuous distributions.
c) find the various measures of random variable and probabilities using its probability distribution.
d) know the relations among the different distributions.
e) understand the concept of transformation of univariate and bivariate continuous random variable.

CONTENTS:

Unit-1: (18 hrs.)

1.1 Discrete Distributions: Poisson, Geometric and Negative Binomial Distribution: Definition of random variable (defined on countably infinite sample space). Poisson Distribution: Definition of Poisson with parameter λ. Mean, variance**,** probability generating function (p. g. f.). Recurrence relation for successive Probabilities, Additive property of Poisson distribution. Poisson distribution as a limiting case of Binomial distribution, examples. Geometric Distribution: Definition of Geometric with parameter p. Mean, Variance, distribution function, p. g. f., Lack of memory property, examples. Negative Binomial Distribution: Definition of Negative Binomial with parameters (k, p), Geometric distribution is a particular case of Negative Binomial distribution, Mean, Variance, p. g. f., Recurrence relation for successive probabilities, examples.

1.2: Continuous Univariate Distributions: 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, skewness and kurtosis, examples. 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. Cumulant generating function (c. g. f.): definition, relations between cumulants and central moments (up to order four). Examples.

Unit-2: (18 hrs.)

2.1 Continuous Bivariate Distributions: Definition of bivariate continuous r. v. (X, Y), Joint p. d. f., c. d. f with properties, marginal and conditional distribution, independence of r. vs., evaluation of probabilities of various regions bounded by straight lines. Expectation of function of r. vs., 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) $E[E(X/Y)] = E(X)$. If X and Y are independent r. vs. then (i) $E(XY) = E(X)\,E(Y)$, (ii) $M_{x+y}(t) = Mx(t) \times My(t)$. Examples.

2.2: Transformations of continuous random variable: 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. Transformation of continuous bivariate r. vs.: Distribution of bivariate r. vs. using Jacobin of transformation. Examples and problems.

References and Recommended Readings

1. Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.
2. Hogg R. V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.
3. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
4. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.
5. Dr. Kore B. G. and Dr. Dixit P. G.: "Probability Distributions-I", Nirali Prakashan, Pune.
6. Mood A.M., Graybill F.A.: Introduction to theory of Statistics. (Chapter II, IV, V, VII) and Boes D.C. Tata, McGraw Hill, New Delhi. (Third Edition)
7. Walpole R.E. & Mayer R.H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) MacMillan Publishing Co. Inc, New York.

****

SHIVAJI UNIVERSITY, KOLHAPUR
CBCS SYLLABUS WITH EFFECT FROM JUNE, 2019
B. Sc. Part-II: SEMESTER III
SUBJECT: STATISTCS -VI
DSC - 8C: Statistical Methods-I
Theory: 36 Hrs. Marks-50 (Credit 2)

OBJECTIVES:

The main objective of this course is to acquaint students with the basic concepts of Multiple Linear Regression, Multiple and Partial Correlation, Sampling Theory and Demography.

By the end of the course students are expected to be able to be:

a) understand the concept of Multiple Linear Regression.
b) understand the concept of Multiple Correlations and Partial Correlation.
c) know the concept of sampling theory.
d) understand the need of vital statistics and concept of mortality and fertility.

CONTENTS:

Unit 1: (18 hrs.)

1.1 Multiple Linear Regression (for trivariate data only): Concept of multiple linear regression, Plane of regression, Yule's notation, correlation matrix. Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation. Residual: definition, order, properties, derivation of mean and variance, Covariance between residuals.

1.2 Multiple and Partial Correlation (for trivariate data only): Concept of multiple correlations. Definition of multiple correlation coefficient $R_{i.jk}$, derivation of formula for multiple correlation coefficient. 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 $R_{i.jk} = 1$, $R_{i.jk} = 0$, coefficient of multiple determination $R^2_{1.23}$. Concept of partial correlation. Definition of partial correlation coefficient $r_{ij.k}$, derivation of formula for $r_{ij.k.}$ Properties of partial correlation coefficient; (i) $-1 \leq r_{ij.k} \leq 1$, (ii) $b_{ij.k} \times b_{ji.k} = r^2_{ij.k}$.

Examples and problems.

Unit-2: (18 hrs.)

2.1 Sampling Theory: Concept of distinguishable elementary units, sampling units, sampling frame, random sampling and non-random sampling. Advantages of sampling method over census method, objectives of a sample survey. Designing a questionnaire, Characteristics of a good questionnaire, Concept of sampling and non-sampling errors. Handling of non- response cases.

Simple random sampling: Simple random sampling from finite population of size N with replacement (SRSWR) and without replacement (SRSWOR): Definitions, population mean and population total as parameters. Following results with proof.

i. In SRSWOR, the probability of a specified unit being selected in sample at any given draw is equal to 1/N.
ii. In SRSWOR, the probability of a specific unit included in the sample is n/N.
iii. In SRSWOR, the probability of drawing a sample of size 'n' from a population of size N units is $\frac{1}{\binom{N}{n}}$.
iv. In SRSWR, the probability of a specific unit included in the sample is $1-\left(1-\frac{1}{N}\right)^n$.
v. In SRSWR, the probability of drawing a sample of size 'n' from a population of size N units is $\frac{1}{N^n}$.

2.2 Demography: Introduction and need of vital statistics. Mortality rates: Crude death rate (CDR), Specific Death Rate (SDR), Standardized Death Rate (STDR). Fertility Rates: Crude Birth Rate (CBR), Age Specific Fertility Rate (ASFR), General Fertility Rate (GFR), Total Fertility Rate (TFR). Reproduction Rate: Gross Reproduction rate (GRR), Net Reproduction Rate (NRR).

References and Recommended Readings

1. Cochran, W.G: Sampling Techniques, Wiley Eastern Ltd., New Delhi.
2. Des Raj: Sampling Theory.
3. Gupta S. C. and Kapoor V. K., "Fundamentals of Applied Statistics", Sultan and Chand, (2010).
4. Dr. Kore B. G. and Dr. Dixit P. G.: "Statistical Methods-I", Nirali Prakashan, Pune.
5. Mukhopadhay, Parimal: Theory and Methods of Survey Sampling, Prentice Hall.
6. Srivastav D. S: A Text book of Demography.
7. Sukhatme, P.V. and Sukhatme, B.V.: Sampling Theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.

****

SHIVAJI UNIVERSITY, KOLHAPUR
CBCS SYLLABUS WITH EFFECT FROM JUNE, 2019
B. Sc. Part-II: SEMESTER IV
SUBJECT: STATISTCS -VII
DSC-7D: Probability Distributions-II
Theory: 36 Hrs. Marks-50 (Credit 2)

OBJECTIVES:

The main objective of this course is to acquaint students with the Uniform, Exponential, Gamma and Beta, Normal distributions and Exact Sampling distributions.

By the end of the course students are expected to be able to:

a) know some standard continuous probability distributions with real life situations.
b) distinguish between various continuous distributions.
c) find the various measures of continuous random variable and probabilities using its probability distribution.

d) understand the relations among the different distributions.
e) understand the Chi-Square, t and F distributions with their applications and inter relations.

CONTENTS:

Unit-1: (18 hrs.)

1.1 **Uniform and Exponential Distribution:** 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. Exponential distribution: p.d.f. (one parameter),

$$f(x) = \theta e^{-\theta x}, x \geq 0, \theta > 0$$

$$= 0 \quad , o.w$$

c.d.f., m.g.f., c.g.f., mean, variance, C.V., moments, Cumulants, median, quartiles, lack of memory property, and distribution of $-(1/\theta)\log X$ where $X \sim U(0, 1)$.

1.2: Gamma and Beta Distributions: 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, β_1, β_2, γ_1 and γ_2 coefficients, additive property: distribution of sum of i.i.d. exponential variates. Beta distribution of first kind: Beta distribution of first kind with parameters m & n. mean, mode, variance, symmetric when m = n, Uniform distribution as a particular case when m = n = 1, distribution of (1-X). Beta distribution of second kind: Beta distribution of second kind with parameters m & n. mean, mode, variance, relation between beta distribution of first kind and second kind, distribution of X+Y, X/Y and X/(X+Y) where X and Y are independent gamma variate.

Unit-2: (18 hrs.)

2.1 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, mean deviation, moments, cumulants, measures of skewness & kurtosis, distribution of linear combination of variates. Distribution of X^2 if $X \sim N(0, 1)$.

2.2: Exact Sampling Distributions: Chi-Square distribution: Definition of chi square, derivation of p.d.f. of chi square distribution with n degrees of freedom using m.g.f., c.g.f., mean, variance, moments, cumulants, mode, skewness and kurtosis, additive property.

Student's t- distribution: Definition of student's t variate. Derivation of p.d.f., mean, mode, variance, moments, β_1, β_2, γ_1 and γ_2 coefficients.

Snedecor's F distribution: Definition of F variate, derivation of p.d.f., mean, variance and mode. Distribution of 1/F. Inter relation between t, F and χ^2 (Without Proof).

References and Recommended Readings

1. Trivedi R. S.: Probability and Statistics with Reliability and Computer Science Application, Prentice – Hall of India Pvt. Ltd., New Delhi.
2. Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.
3. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.
4. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.
5. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
6. Gupta S. C. & Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.
7. Dr. Kore B. G., Dr. Dixit P. G. and Mr. P. S. Kapre: "Probability Distributions-II",

Nirali Prakashan, Pune.
8. Mood A.M., Graybill F.A.: Introduction to theory of Statistics. (Chapter II, IV, V, VII) and Boes D.C. Tata, McGraw Hill, New Delhi. (Third Edition)
9. Walpole R.E. & Mayer R.H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) MacMillan Publishing Co. Inc, New York

****

SHIVAJI UNIVERSITY, KOLHAPUR
CBCS SYLLABUS WITH EFFECT FROM JUNE, 2019
B. Sc. Part-II: SEMESTER IV
SUBJECT: STATISTICS - VIII
DSC-8D: Statistical Methods-II
Theory: 36 Hrs. Marks-50 (Credit 2)

OBJECTIVES:

The main objective of this course is to acquaint students with the concepts of Time Series, Statistical Quality Control, Testing of Hypothesis.

By the end of the course students are expected to be able to:

a) know the concept and use of time series.
b) understand the meaning, purpose and use of Statistical Quality Control, construction and working of control charts for variables and attributes
c) apply the small sample tests and large sample tests in various situations.

CONTENTS:

Unit-1: (18 hrs.)

1.1 **Time Series:** Meaning and need of time series analysis, components of time series; (i) Secular trend (ii) Seasonal Variation (iii) Cyclical Variation (iv) Irregular Variation, Additive and Multiplicative model, utility of time series. Measurement of trend: (i) Moving averages method (ii) Progressive average method (iii) Least square method. (iv) Measurement of seasonal indices by simple average method.

1.2 Statistical Quality Control: Meaning and purpose of S.Q.C., Process control, Product control, chance causes, assignable causes, Shewhart's control chart- construction & working, lack of control situation. Control charts for variables - control chart for mean, control chart for range, construction and working of mean & range charts for unknown standards, revised control limits. Control charts for Attributes – Defects, defectives, fraction defective, control chart for fraction defective (p-chart) for fixed sample size and unknown standards, construction and working of chart. Control charts for number of defects (C-chart), for unknown standards, construction and working of C-chart.

Unit 2: (18 hrs.)

2.1 **Testing of Hypothesis - I:** 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, power of test. Large Sample Tests: General procedure of testing of hypothesis. a) Tests for means: i) testing of population mean; $H0: \mu = \mu_0$, ii) testing equality of population means; $H_0: \mu_1 = \mu_2$ b) Tests for Proportion: i) testing of population Proportion; $H_0: P = P_0$ ii) testing equality of population Proportion; $H_0: P_1 = P_2$ c) test for population correlation: i) $H_0: \rho = \rho_0$ ii) $H0: \rho_1 = \rho_2$ (by Z-transformation)

2.2: Testing of Hypothesis - II (Small sample tests): Definition of Fisher's t- variate, t - test: a) test for means: i) $H0: \mu = \mu_0$, ii) $H_0: \mu_1 = \mu_2$, $(\sigma_1^2 = \sigma_2^2)$, iii) Paired t- test,

χ^2 - test: i) test for population variance H_0: $\sigma^2 = \sigma_0^2$ (Mean known and unknown), ii) test for goodness of fit, iii) test for independence of attributes; a) m x n contingency table, b) 2 x 2 contingency table, test statistic with proof. Yate's correction for continuity.

F – test: test for equality of two population variances H_0: $\sigma_1^2 = \sigma_2^2$.

References and Recommended Readings

1. Barlow R. E. and Proschan Frank, "Statistical Theory of Reliability and Life Testing", Holt Rinebart and Winston Inc., New Yark.
2. Chatfield C. (2004), "The Analysis of Time Series –An Introduction", Chapman & Hall.
3. Gupta S. C. & Kapoor V. K., "Fundamentals of Applied Statistics", Sultan Chand & Sons, New Delhi.
4. Kendall M.G. (1978), "Time Series", Charles Griffin.
5. Dr. Kore B. G. and Dr. Dixit P. G.: "Statistical Methods-II", Nirali Prakashan, Pune.
6. Montgomery D. C. (2009). "Introduction to quality Control", Jon Wiley and sons.
7. Sinha S. K., "Reliability and Life Testing", Second Edition, Wiley Eastern Publishers, New Delhi.
8. Snedecor G.W. and Cochoran W. G. "Statistical Methods", Lowa State University Press.

****

Equivalence for Theory Papers

Old Syllabus		New Syllabus	
Semester No. Paper No.	**Title of the Paper**	**Semester No. Paper No.**	**Title of the Paper**
Sem. III Paper V	Probability Distributions-I	Sem. III DSC – 7C - **STATISTICS - V**	Probability Distributions-I
Sem. III Paper VI	Statistical Methods-I	Sem. III DSC – 8C - **STATISTICS - VI**	Statistical Methods-I
Sem. IV Paper VII	Probability Distributions-II	Sem. IV DSC – 7D - **STATISTICS - VII**	Probability Distributions-II
Sem. IV Paper VIII	Statistical Methods-II	Sem. IV DSC – 8D - **STATISTICS - VIII**	Statistical Methods-II

****

SHIVAJI UNIVERSITY, KOLHAPUR
CBCS SYLLABUS WITH EFFECT FROM JUNE, 2019
B. Sc. Part-II
SUBJECT: STATISTICS - Practical
Practical: 192 Hrs. Marks -100 (Credit 4)

OBJECTIVES:

By the end of the course students are expected to be able to:

a) compute probabilities of standard probability distributions.
b) compute the expected frequency and test the goodness of fit.
c) understand how to obtain random sample from standard probability distribution and

sketch of the p. m. f. / p. d. f. for given parameters.

d) fit plane of Multiple regression and compute Multiple and Partial correlation coefficients.
e) draw random samples by various sampling methods
f) construct various control charts.
g) understand the applications of Poisson, Geometric and Negative Binomial distributions.

Practical – II (Credit 2)

1. Fitting of Discrete Uniform distribution.
2. Fitting of Binomial distribution.
3. Fitting of Hypergeometric distribution.
4. Fitting of Poisson distribution.
5. Fitting of Geometric distribution.
6. Fitting of Negative Binomial
7. Model sampling from Discrete Uniform distribution.
8. Model sampling from Binomial distribution.
9. Model sampling from Hypergeometric distribution.
10. Model sampling from Poisson distribution.
11. Model sampling from Geometric distribution.
12. Model sampling from Negative Binomial distribution
13. Fitting of Continuous Uniform distribution
14. Fitting of Exponential distribution
15. Fitting of Normal distribution.
16. Model sampling from Continuous Uniform distribution.
17. Model sampling from Exponential distribution.
18. Model sampling from Normal distribution using: (i) Normal table and (ii) Box-Muller transformation.
19. Fitting of Binomial, Poisson & Negative Binomial distribution using MS-EXCEL.
20. Fitting of Exponential & Normal distribution using MS-EXCEL.

Practical - III (Credit 2)

1. Applications of Poisson distribution.
2. Applications of geometric and negative binomial distributions.
3. Applications of Exponential & Normal distribution
4. Multiple regression.
5. Multiple correlation.
6. Partial correlation.
7. Simple Random Sampling.
8. Demography I (Mortality rates).
9. Demography II (Fertility and Reproduction rates).
10. Time Series. (Trend by moving average & least square methods. Seasonal indices by simple average method).
11. Construction of R and $\overline{X}$ charts
12. Construction of P and C charts.
13. Large sample tests for means.
14. Large sample tests for proportions.
15. Tests for population correlation coefficients. (Using Fisher's Z transformation.)
16. Tests based on Chi square distribution. (Test for population variance, Test for goodness of fit, Tests for independence.)

17. Tests based on t distribution ($\mu = \mu_0$, $\mu_1 = \mu_2$; paired t test)
18. Tests based on F distribution. ($\sigma_1 = \sigma_2$,)
19. Sketch of discrete distributions: Binomial, Poisson, Geometric and Negative Binomial distribution for various parameters using MS-EXCEL.
20. Sketch of continuous distributions: Exponential, Gamma and Beta distributions for various parameters using MS-EXCEL.

Note:

1. For fitting of all distributions, test of goodness of fit is necessary.
2. For model sampling from all distributions, inverse c. d. f. transformation method has to be used in Practical-II.
3. For experiment no. 1 to 6 in Practical-II, Probabilities has to be calculated by recurrence relation only.
4. There should be at least FOUR problems in each experiment.
5. Computer printout is to be attached to the journal for the experiment based on MS-EXCEL.
6. Observation table and/or calculations using statistical formulae should be done by MS-EXCEL and verify by using library functions for the experiment based on MS-EXCEL.
7. Student must complete the entire practical to the satisfaction of the teacher concerned.
8. Student must produce the laboratory journal along with the completion certificate signed by Head of Department, at the time of practical examination.
9. There will be study tour or case study. A report on the same has to be submitted by every student along with the journal.

Laboratory requirements:

Laboratory should be well equipped with sufficient number of electronic calculators and computers along with necessary software, printers and UPS.

Nature of Practical Question Paper of B. Sc. Part – II.

a) Each practical paper is of 50 marks, containing four questions each of 20 marks and students has to solve any two questions. There should be one sub question of 10 marks based on MS-EXCEL in any one of the four questions.
b) Evaluation of MS-EXCEL based question will be on line and should be demonstrated by the student to the examiner.
c) 5 marks are reserved for journal and 5 marks are reserved for oral in practical paper-II examination.
d) 5 marks are reserved for journal and 5 marks are reserved for study tour report / Case study in practical paper - III examination.
e) Practical examination is of 4 hours duration which includes oral as well as online demonstration.
f) There should be two subject experts at the time of practical examination.

****