

University of Kalyani



**CBCS CURRICULUM FOR SEMESTERIZED UNDER-GRADUATE COURSE
IN
STATISTICS (PROGRAMME/GENERAL)**

**WITH EFFECT FROM THE ACADEMIC SESSION
2018-19**

CBCS CURRICULUM FOR SEMESTERIZED UNDER-GRADUATE COURSE IN STATISTICS (PROGRAMME/GENERAL)

INTRODUCTION:

The University Grants Commission (UGC) has taken various measures by means of formulating regulations and guidelines and updating them, in order to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions in India. The various steps that the UGC has initiated are all targeted towards bringing equity, efficiency and excellence in the Higher Education System of country. These steps include introduction of innovation and improvements in curriculum structure and content, the teaching-learning process, the examination and evaluation systems, along with governance and other matters. The introduction of Choice Based Credit System is one such attempt towards improvement and bringing in uniformity of system with diversity of courses across all higher education institutes in the country. The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective, skill enhancement or ability enhancement courses. The courses shall be evaluated following the grading system, is considered to be better than conventional marks system. This will make it possible for the students to move across institutions within India to begin with and across countries for studying courses of their choice. The uniform grading system shall also prove to be helpful in assessment of the performance of the candidates in the context of employment.

Outline of the Choice Based Credit System being introduced:

1. **Core Course (CC):** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the student's proficiency/skill is termed as an Elective Course.

2.1 **Discipline Specific Elective Course (DSEC):** Elective courses that are offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Generic Elective Course (GEC):** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

3. Ability Enhancement Courses/ Skill Enhancement Courses:

3.1 **Ability Enhancement Compulsory Course (AECC):** Ability enhancement courses are the courses based upon the content that leads to Knowledge enhancement. They (i) Environmental Science, (ii) English Communication) are mandatory for all disciplines.

3.2 **Skill Enhancement Course (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

CBCS CURRICULUM FOR SEMESTERIZED UNDER-GRADUATE COURSE IN
----- (PROGRAMME/GENERAL)

A. TOTAL Number of courses in UG-CBCS (B.A./B.Sc./B.Com. PROGRAMME /GENERAL):

Types of course	Core course (CC)	Elective course		Ability Enhncemnt Course		T O T A L
		Discipline specific elective course (DSE)	Generic elective course(GE)	Ability Enhancmnt compulsory course(AECC)	Skill Enhancmnt course (SEC)	
No. of course	12	6(BSc)/4(BA/B.Com)	2((BA/B.Com)	2	2	24
Credit/course	6	6	6	2	2	120

TABLE-1: DETAILS OF COURSES OF B.A./ B.SC./ B.COM.(PROGRAMME/ GENERAL) UNDER CBCS

S. No.	Particulars of Course	Credit Point	
1.	Core Course: 14 Papers	Theory + Practicl	Theory + Tutoril
1.A.	Core Course: Theory (12 papers)	12x4 = 48	12x5 = 60
1.B.	Core Course (Practical/Tutorial)*(12 papers)	12x2 = 24	12x1 = 12
2.	Elective Courses: (6 papers)		
A.	DSE (6 papers for B.Sc./ 4 papers for B.A. & B.Com.)	6x4 = 24	4x5 = 20
B.	DSE(Pract./ Tutor.)* (6 papers for B.Sc./4 for B.A. & B.Com.)	6x2 = 12	4x1 = 4
C.	GE (Interdisciplinary) (2 papers for B.A. & B.Com.)	--	2x5 = 10
D.	GE (Pract./Tutor.)* (4 papers) (2 papers for B.A. & B.Com.)	--	2x1 = 2
#Optional Dissertation/ Project Work in place of one DSE paper (6 credits) in 6th semester			
3.	Ability Enhancement Courses		
A.	AECC(2 papers of 2 credits each) ENVS, English Communication / MIL	2x2 = 4	2x2 = 4
B.	Skill Enhancement Course(SEC) (4 papers of 2 credits each)-----	4x2 = 8	4x2 = 8
Total Credit:		120	120
## Wherever there is a practical, there will be no tutorial and vice- versa.			

TABLE-2: SEMESTER WISE DISTRIBUTION OF COURSES & CREDITS IN B.A./B.COM. (PROGRAMME/ GENERAL)

Courses/ (Credits)	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Total No. of Courses	Total credit
CC-1,2 (6)	2(1A,2A)	2 1B,2B)	2 (1C,2C)	2 (1D,2D)			8	48
Language CC - 1,2 (6)	1 (L ₁ -1)	1 (L ₂ -1)	1 (L ₁ -2)	1 (L ₂ -2)			4	24
DSE (6)	-	-	-	-	2(1A,2A)	2 (1B,2B)	4	24
GE (6)					1(GE-1)	1(GE-2)	2	12
AECC (2)	1	1					2	04
SEC (2)			1	1	1	1	4	08
Total No. of Courses/ Sem.	4	4	4	4	4	4	24	--
Total Credit /Semester	20	20	20	20	20	20	--	120

TABLE-2: SEMESTER WISE DISTRIBUTION OF COURSES & CREDITS IN B.SC. (PROGRAMME /GENERAL)

Courses / (Credits)	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Total No. of Courses	Total credit
CC-1,2,3 (6)	3 (1A,2A,3A)	3 (1B,2B,3B)	3 (1C,2C,3C)	3 (1D,2D,3D)			12	72
DSE - 1,2,3 (6)	-	-	-	-	3 (1A,2A,3A)	3 (1B,2B,3B)	6	36
GE (6)	--	--	--	--	--	--	--	--
AECC (2)	1	1					2	04
SEC (2)			1	1	1	1	4	08
Total No. of Course/ Sem	4	4	4	4	4	4	24	--
Total Credit /Semester	20	20	20	20	20	20	--	120

**TABLE-3: SEMESTER & COURSEWISE CREDIT DISTRIBUTION IN B.SC.(PROGRAMME/ GENERAL)
(6 Credit: 75 Marks)**

SEMESTER-I			
Course Code	Course Title	Course wise Class (L+T+P)	Credit
STATGCC – 1A	Statistical Methods (Th)	50	4
	Statistical Methods Lab (Prac)	25	2
CC – 2A (Other Discipline)			6
CC – 3A (Other Discipline)			6
AECC - 01	ENVS		2
Total	4 courses	Total	20
SEMESTER-II			
Course Code	Course Title	Course wise Class	Credit
STATGCC – 1B	Introductory Probability (Th)	50	4
	Introductory Probability Lab (Prac)	25	2
CC – 2B (Other Discipline)			6
CC – 3B (Other Discipline)			6
AECC - 02	English Communication		2
Total	4 courses	Total	20
SEMESTER-III			
Course Code	Course Title	Course wise Class	Credit
STATGCC – 1C	Basics of Statistical Inference (Th)	50	4
	Basics of Statistical Inference Lab (Prac)	25	2
CC – 2C (Other Discipline)			6
CC – 3C (Other Discipline)			6
STATGSEC – 1A	MS-EXCEL	25	2
Total	4 courses	Total	20
SEMESTER-IV			
Course Code	Course Title	Course wise Class	Credit
STATGCC – 1D	Applied Statistics (Th)	50	4
	Applied Statistics Lab (Prac)	25	2
CC – 2D (Other Discipline)			6
CC – 3D (Other Discipline)			6
STATGSEC – 1B	Monte Carlo Method	25	2
Total	4 courses	Total	20
SEMESTER-V			

Course Code	Course Title	Course wise Class	Credit
STATGDSE – 1A	Statistical Quality Control/Operations Research	50+25	4+2
DSE – 2A (Other Discipline)			6
DSE – 3A (Other Discipline)			6
STATGSEC – 1C	MINITAB	25	2
Total	4 courses	Total	20
SEMESTER-VI			
Course Code	Course Title	Course wise Class	Credit
STATGDSE – 1B	Survival Analysis/Actuarial Statistics	50+25	4+2
DSE – 2B (Other Discipline)			6
DSE – 3B (Other Discipline)			6
STATGSEC – 1D	Research Methodology	25	2
Total	4 courses	Total	20
Total (All semesters)	24 courses	Total	120

**Detaild Course & Contents of each subject specific syllabus will be given as per standard format as provided below.*

❖ COURSE CODE & COURSE TITLE:

A. Core courses (CC)

1. STATGCC – 1A : Statistical Methods
2. CC – 2A (Other Discipline)
3. CC – 3A (Other Discipline)
4. STATGCC – 1B : Introductory Probability
5. CC – 2B (Other Discipline)
6. CC – 3B (Other Discipline)
7. STATGCC – 1C : Basics of Statistical Inference
8. CC – 2C (Other Discipline)
9. CC – 3C (Other Discipline)
10. STATGCC – 1D : Applied Statistics
11. CC – 2D (Other Discipline)
12. CC – 3D (Other Discipline)

B. Discipline specific elective courses (DSE)

1. STATHDSE – 1A : Statistical Quality Control/Operations Research
2. DSE – 2A (Other Discipline)
3. DSE – 3A (Other Discipline)
4. STATGDSE – 1B : Survival Analysis/Actuarial Statistics
5. DSE – 1B (Other Discipline)
6. DSE – 1B (Other Discipline)

D. Ability enhancement compulsory courses (AECC)

1. AECC-01: ENVS
2. AECC-02: English Communication

E. Skill enhancement courses (SEC)

1. STATGSEC – 1A : MS-EXCEL
2. STATGSEC – 1B : Monte Carlo Method
3. STATGSEC – 1C : MINITAB
4. STATGSEC – 1D : Research Methodology

B.Sc. STATISTICS (PROGRAMME /GENERAL)

SEMESTER – I

STATGCC-1A

Statistical Methods (Th) Credit 4

After completion of the course the learners will be able to deal with different representations, analyses and interpretations of statistical data, at least at a primary level.

Unit 1

Introduction: Definition and scope of Statistics, concepts of statistical population and sample.

Data: quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Frequency distribution, **Presentation:** tabular and graphic, including histogram and ogives.

Unit 2

Measures of Central Tendency : mathematical and positional.

Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis.

Unit 3

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation (Spearman). Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

Unit 4

Theory of attributes, consistency of data, independence and association of attributes, measures of association and contingency.

Statistical Methods Lab (Prac) Credit 2

List of Practical

1. Graphical representation of data
2. Problems based on measures of central tendency
3. Problems based on measures of dispersion
4. Problems based on combined mean and variance and coefficient of variation
5. Problems based on moments, skewness and kurtosis
6. Fitting of polynomials, exponential curves
7. Karl Pearson correlation coefficient
8. Partial and multiple correlations

9. Spearman rank correlation with and without ties.
10. Correlation coefficient for a bivariate frequency distribution
11. Lines of regression, angle between lines and estimated values of variables.
12. Checking consistency of data and finding association among attributes.

Suggested Reading:

- Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I& II, 8th Edn. The World Press, Kolkata.
- Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
- Mood, A.M. Graybill, F.A. And Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
- Goon A.M., Gupta M.K. and Dasgupta B. : Basic Statistics. The World Press, Kolkata.
- Chakraborty, Arnab (2016) : Probability and Statistics. Sarat Book House

SEMESTER – II

STATGCC-1B

Introductory Probability (Th) Credit 4

After completion of the course the learners will be able to grasp the theory of probability and distributions that are useful in drawing inferences from statistical data.

Unit 1

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

Unit 2

Random Variables: Discrete and continuous random variables, p.m.f., p.d.f., c.d.f. Illustrations of random variables and its properties. Expectation, variance, moments and moment generating function.

Unit 3

Convergence in probability, almost sure convergence, Chebyshev's inequality, weak law of large numbers, De-Moivre Laplace and Lindeberg-Levy Central Limit Theorem (C.L.T).

Unit 4

Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, exponential, beta, gamma.

Introductory Probability Lab (Prac) Credit 2

List of Practical

1. Fitting of binomial distributions for n and $p = q = \frac{1}{2}$ given
2. Fitting of binomial distributions for n and p given
3. Fitting of binomial distributions computing mean and variance
4. Fitting of Poisson distributions for given value of λ
5. Fitting of Poisson distributions after computing mean
6. Application problems based on binomial distribution
7. Application problems based on Poisson distribution
8. Problems based on area property of normal distribution
9. To find the ordinate for a given area for normal distribution

10. Application based problems using normal distribution
11. Fitting of normal distribution when parameters are given
12. Fitting of normal distribution when parameters are not given

Suggested Reading:

- Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
- Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
- Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi
- Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
- Chakraborty, Arnab (2016): Probability and Statistics. Sarat Book House.
- Ross, S. (2002): A First Course in Probability, Prentice Hall.

SEMESTER – III

STATGCC-1C

Basics of Statistical Inference (Th) Credit 4

After completion of the course the learners will be able to know how inferences e.g. statistical estimation and hypothesis testing are carried out for different types of data.

Unit 1

Estimation of population mean, confidence intervals for the parameters of a normal distribution (one sample and two sample problems).

The basic idea of significance test. Null and alternative hypothesis. Type I & Type II errors, level of significance, concept of p-value. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).

Unit 2

Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi-square test, Yates' correction.

Unit 3

Tests for the significance of correlation coefficient. Sign test for median, Sign test for symmetry, Wilcoxon two-sample test.

Unit 4

Analysis of variance, one-way and two-way classification. Brief exposure of three basic principles of design of experiments, treatment, plot and block. Analysis of completely randomized design, randomized complete block design. Bioassay.

Basics of Statistical Inference Lab (Prac) Credit 2

List of Practical

1. Estimators of population mean.
2. Confidence interval for the parameters of a normal distribution (one sample and two sample problems).
3. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).
4. Chi-square test of proportions.
5. Chi-square tests of association.
6. Chi-square test of goodness-of-fit.
7. Test for correlation coefficient.
8. Sign test for median.
9. Sign test for symmetry.
10. Wilcoxon two-sample test.
11. Analysis of Variance of a one way classified data
12. Analysis of Variance of a two way classified data.
13. Analysis of a CRD.

14. Analysis of an RBD.

Suggested Reading:

1. Daniel, Wayne W., Bio-statistics: A Foundation for Analysis in the Health Sciences. John Wiley (2005).
2. Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).
3. Das, M. N. & Giri, N. C.: Design and analysis of experiments. John Wiley.
4. Dunn, O.J Basic Statistics: A primer for the Biomedical Sciences .(1964, 1977) by John Wiley.
5. Bancroft, Holdon: Introduction to Bio-Statistics (1962) P.B. Hoebar New York.
6. Goldstein, A: Biostatistics-An introductory text (1971). The Macmillan, New York.

STATGSEC-1A

MS-EXCEL Credit 2

After completion of the course the learners will be able to know about basic EXCEL commands and how they are used for statistical analysis of data.

- (i) Use of Spreadsheet.
- (ii) Drawing diagrams – bar, column, line, pie, scatter.
- (iii) Use of functions – mathematical, statistical and logical.
- (iv) Line diagrams showing different types of time series data, determination of trend by moving averages and curve fitting methods, plotting fitted values.
- (v) Exponential smoothing of a time series.

SEMESTER – IV

STATGCC-1D

Applied Statistics (Th) Credit 4

After completion of the course the learners will be able to know different applications of statistics in economy, time series, industrial statistics, demography etc.

Unit 1

Economic Time Series: Components of time series, Decomposition of time series- Additive and multiplicative model with their merits and demerits, Illustrations of time series. Measurement of trend by method of free-hand curve, method of semi-averages and method of least squares (linear, quadratic and modified exponential). Measurement of seasonal variations by method of ratio to trend.

Unit 2

Index numbers: Definition, Criteria for a good index number, different types of index numbers. Construction of index numbers of prices and quantities, consumer price index number. Uses and limitations of index numbers.

Unit 3

Statistical Quality Control: Importance of statistical methods in industrial research and practice. Determination of tolerance limits. Causes of variations in quality: chance and assignable. General theory of control charts, process & product control, Control charts for variables: X- bar and R-charts. Control charts for attributes: p and c-charts

Unit 4

Demographic Methods: Introduction, measurement of population, rates and ratios of vital events. Measurement of mortality: CDR, SDR (w.r.t. Age and sex), IMR, Standardized death rates.

Life (mortality) tables: definition of its main functions and uses. Measurement of fertility and reproduction: CBR, GFR, and TFR. Measurement of population growth: GRR, NRR.

Applied Statistics Lab (Prac) Credit 2

List of Practical

1. Measurement of trend: Fitting of linear, quadratic trend, exponential curve and plotting of trend values and comparing with given data graphically.
2. Measurement of seasonal indices by Ratio-to-trend method and plotting of trend values and comparing with given data graphically.
3. Construction of price and quantity index numbers by Laspeyre's formula, Paasche's formula, Marshall-Edgeworth's formula, Fisher's Formula. Comparison and interpretation.
4. Construction of wholesale price index number, fixed base index number and consumer price index number with interpretation
5. Construction and interpretation of X bar & R-chart
6. Construction and interpretation p-chart (fixed sample size) and c-chart
7. Computation of measures of mortality
8. Completion of life table
9. Computation of measures of fertility and population growth

Suggested Reading:

1. Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency, Calcutta.
2. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9th Edition World Press, Kolkata.
3. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals Of Applied Statistics, 4th Edition(Reprint), Sultan Chand & Sons
4. Montgomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.

STATGSEC-1B

Monte Carlo Method Credit 2

After completion of the course the learners will be able to be acquainted with different simulation techniques useful in real life situations.

Unit 1

The need for Monte Carlo Techniques; history; example applications. .Rejection method; variance reduction; importance sampling.

Unit 2

convergence of Markov chains; detailed balance; limit theorems.

Unit 3

4. **Basic MCMC algorithms:** Metropolis-Hastings algorithm; Gibbs sampling.

Unit 4

Implementational issues: Burn In; Convergence diagnostics, Monte Carlo error.

Suggested Reading:

1. C.P.Robert and G.Casella, Monte Carlo Statistical Methods (2nd Ed.), Springer, 2004.
2. J. Voss "An introduction to Statistical Computing: A Simulation-Based Approach"
3. J.S. Liu, Monte Carlo Strategies in Scientific Computing, Springer, 2001.

SEMESTER – V

STATGDSE-1A

Statistical Quality Control (Th) Credit 4

After completion of the course the learners will be able to know how statistical techniques are used in industries for maintaining quality of products.

Unit 1

Quality: Definition, dimensions of quality, historical perspective of quality control and improvements starting from World War II, historical perspective of Quality Gurus and Quality Hall of Fame. Quality system and standards: Introduction to ISO quality standards, Quality registration.

Unit 2

Statistical Process Control - Seven tools of SPC, chance and assignable Causes of quality variation. Statistical Control Charts- Construction and Statistical basis of 3- σ Control charts, Rational Sub-grouping.

Unit 3

Control charts for variables: X-bar & R-chart, X-bar & s-chart. Control charts for attributes: np-chart, p-chart, c-chart and u-chart. Comparison between control charts for variables and control charts for attributes. Analysis of patterns on control chart, estimation of process capability.

Unit 4

Acceptance sampling plan: Principle of acceptance sampling plans. Single and Double sampling plan their OC, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation, use and interpretation of Dodge and Romig's sampling inspection plan tables.

Statistical Quality Control Lab (Prac) Credit 2

1. Construction and interpretation of statistical control charts:

- X-bar & R-chart
- X-bar & s-chart
- np-chart
- p-chart
- c-chart
- u-chart

2. Single sample inspection plan: Construction and interpretation of OC, AQL, LTPD, ASN, ATI, AOQ, AOQL curves

3. Calculation of process capability and comparison of 3-sigma control limits with specification limits.

Suggested Reading:

1. Montgomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.
2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I

& II, 8th Edn. The World Press, Kolkata.

3. Mukhopadhyay, P (2011): Applied Statistics, 2nd edition revised reprint, Books and Allied(P) Ltd.

4. Montgomery, D. C. and Runger, G.C. (2008): Applied Statistics and Probability for Engineers, 3rd Edition reprint, Wiley India Pvt. Ltd.

5. Ehrlich, B. Harris (2002): Transactional Six Sigma and Lean Servicing, 2nd Edition, St. Lucie Press.

6. Hoyle, David (1995): ISO Quality Systems Handbook, 2nd Edition, Butterworth Heinemann Publication.

Operations Research (Th) Credit 4

After completion of the course the learners will be able to learn different optimization techniques useful in practical fields including transportation, inventories etc.

Unit 1

Introduction to Operations Research, phases of O.R., model building, various types of O.R. problems. Linear Programming Problem, Mathematical formulation of the L.P.P, graphical solutions of a L.P.P. Simplex method for solving L.P.P. Charne's M-technique for solving L.P.P. involving artificial variables. Special cases of L.P.P. Concept of Duality in L.P.P: Dual simplex method. Post-optimality analysis

Unit 2

Transportation Problem: Initial solution by North West corner rule, Least cost method and Vogel's approximation method (VAM), MODI's method to find the optimal solution, special cases of transportation problem. Assignment problem: Hungarian method to find optimal assignment, special cases of assignment problem.

Unit 3

Game theory: Rectangular game, minimax-maximin principle, solution to rectangular game using graphical method, dominance and modified dominance property to reduce the game matrix and solution to rectangular game with mixed strategy. Networking: Shortest route and minimal spanning tree problem.

Unit 4

Inventory Management: ABC inventory system, characteristics of inventory system. EOQ Model and its variations, with and without shortages, Quantity Discount Model with price breaks.

Operations Research Lab (Prac) Credit 2

1. Mathematical formulation of L.P.P and solving the problem using graphical method, Simplex technique and Charne's Big M method involving artificial variables.
2. Identifying Special cases by Graphical and Simplex method and interpretation
 - a. Degenerate solution
 - b. Unbounded solution
 - c. Alternate solution
 - d. Infeasible solution
3. Allocation problem using Transportation model
4. Allocation problem using Assignment model

5. Problems based on game matrix
 - a. Graphical solution to $m \times n$ / $2 \times n$ rectangular game
 - b. Mixed strategy
6. To find optimal inventory policy for EOQ models and its variations

Suggested Reading:

1. Taha, H. A. (2007): Operations Research: An Introduction, 8th Edition, Prentice Hall of India.
2. KantiSwarup, Gupta, P.K. and Manmohan (2007): Operations Research, 13th Edition, Sultan Chand and Sons.
3. Hadley, G: (2002) : Linear Programming, Narosa Publications
4. Hillier, F.A and Lieberman, G.J. (2010): Introduction to Operations Research- Concepts and cases, 9th Edition, Tata McGraw Hill

STATGSEC-1C

MINITAB Credit 2

After completion of the course the learners will be able to learn computations in connection with basic statistical techniques through this software.

Use of MINITAB using the options under 'CALCULATION' and 'STATISTICS'.

Some suggested problems:

- (i) Basic statistics – display, descriptive measures (univariate only), one-sample z and t tests, two-sample and paired t tests for proportion, tests for one and two variances and correlations.
- (ii) Regression: Linear and multiple regression – fitted and residual plots.
- (iii) ANOVA: one-way and two-way classified data.
- (iv) Control charts: mean, mean-range, mean-s.d., proportion, number of defectives, number of defects charts.

SEMESTER – VI

STATGDSE-1B

Survival Analysis (Th) Credit 4

After completion of the course the learners will be able to know different distributions useful in life-testing, survivorship, epidemiology etc. Students will also learn how different functions relating to to above are estimated.

Unit 1

Survival Analysis: Functions of survival times, survival distributions and their applications, exponential, gamma, Weibull, Rayleigh, lognormal, death density function for a distribution having bath-tub shaped hazard function.

Unit 2

Censoring Schemes: Type I, Type II and progressive or random censoring with biological examples. Estimation of mean survival time and variance of the estimator for Type I and Type II censored data with numerical examples. Non-parametric methods: Actuarial and Kaplan-Meier methods for estimating survival function and variance of the Estimator.

Unit 3

Competing Risk Theory: Indices for measurement of probability of death under competing risks and their inter-relations. Estimation of probabilities of death using maximum likelihood principle and modified minimum Chi-square methods. Theory of independent and dependent risks. Bivariate normal dependent risk model.

Unit 4

Stochastic Epidemic Models: Simple epidemic models, general epidemic model definition and concept (without derivation). Duration of an epidemic.

Survival Analysis Lab (Prac) Credit 2

List of Practical

1. To estimate survival function
2. To determine death density function and hazard function
3. To identify type of censoring and to estimate survival time for type I censored data
4. To identify type of censoring and to estimate survival time for type II censored data
5. To identify type of censoring and to estimate survival time for progressively type I censored data
6. Estimation of mean survival time and variance of the estimator for type I censored data
7. Estimation of mean survival time and variance of the estimator for type II censored data
8. Estimation of mean survival time and variance of the estimator for progressively type I censored data
9. To estimate the survival function and variance of the estimator using Non-parametric methods with Kaplan-Meier method

Suggested Reading:

1. Lee, E.T. and Wang, J.W. (2003): Statistical Methods for Survival Data Analysis, 3rd Edition, John Wiley and Sons.
2. Kleinbaum, D.G. (1996): Survival Analysis, Springer.

Actuarial Statistics (Th) Credit 4

After completion of the course the learners will be able to learn how statistical techniques are used in insurance applications. They will know how premium rates, annuities etc. are calculated.

Unit 1

Introductory Statistics and Insurance Applications: Discrete, continuous and mixed probability distributions. Insurance applications, sum of random variables. Utility theory: Utility functions, expected utility criterion, types of utility function, insurance and utility theory.

Unit 2

Principles of Premium Calculation: Properties of premium principles, examples of premium principles. Individual risk models: models for individual claims, the sum of independent claims, approximations and their applications.

Unit 3

Survival Distribution and Life Tables: Uncertainty of age at death, survival function, time until death for a person, curate future lifetime, force of mortality, life tables with examples, deterministic survivorship group, life table characteristics, assumptions for fractional age, some analytical laws of mortality.

Unit 4

Life Insurance: Models for insurance payable at the moment of death, insurance payable at the end of the year of death and their relationships. Life annuities: continuous life annuities, discrete life annuities, life annuities with periodic payments. Premiums: continuous and discrete premiums.

Actuarial Statistics Lab (Prac) Credit 2**List of Practical**

1. Risk computation for different utility models
2. Discrete and continuous risk calculations
3. Calculation of aggregate claims for collective risks
4. Calculation of aggregate claim for individual risks
5. Computing Ruin probabilities and aggregate losses
6. Annuity and present value of contract
7. Computing premium for different insurance schemes
8. Practical based on life models and tables

Suggested Reading:

1. Dickson, C. M. D. (2005): Insurance Risk And Ruin (International Series On Actuarial Science), Cambridge University Press.
2. Bowers, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A. And Nesbitt, C. J. (1997): Actuarial Mathematics, Society Of Actuaries, Itasca, Illinois, U.S.A.

STATGSEC-1D**Research Methodology Credit 2**

After completion of the course the learners will be able to know what are the different stages of research, how a good research work is conducted, how statistical data analyses are done and incorporated in the thesis etc.

Unit 1

Introduction to research, meaning of research, role of research in important areas, process of research, types of research, Unit of analysis, characteristics of interest. Research problem as a problem of hypothesis testing.

Unit 2

Data Processing: Introduction, editing of data, coding of data, classification of data, tables as data presentation devices, graphical presentation of data

Unit 3

Data Analysis: An overview on techniques in univariate, bivariate and multivariate data Models and Model Building: role of models, types of models, objectives of modeling, model building/ model development, model validation, simulation models.

Unit 4

Formats of Reports: introduction, parts of a report, cover and title page, introductory pages, text, reference section, typing instructions, copy reading, proof reading.
Presentation of a report: introduction, communication dimensions, presentation package, audio-visual aids, presenter's poise.

Suggested Reading:

- Kotahri, C.R (2009): Research Methodology: Methods and Techniques, 2nd Revised Ed. Reprint, New Age International Publishers
2. Lilien, Gary L. and Philip Kotler, 1983. Marketing Decision Making; A Model Building Approach, Harper & Row, New York.
 3. Shenoy, GVS, et al., (1983). Quantitative Techniques for Managerial Decision Making, Wiley Eastern.