

AC 19/3/2012

Item No. 4.89

# **UNIVERSITY OF MUMBAI**



**Syllabus for the S.Y.B.A.**

**Program: B.A.**

**Course :STATISTICS**

(Credit Based Semester and Grading System with  
effect from the academic year 2012–2013)

**S.Y.B.A. STATISTICS Syllabus**  
**Restructured for Credit Based and Grading System**  
**To be implemented from the Academic year 2012-2013**

Schemes For S.Y.B.A STATISTICS

1)Scheme A : Students who have opted for ONE paper at F.Y.B.A.

Statistics(Namely Scheme A) will continue the scheme A at S.Y.B.A. that is opt for TWO papers at S.Y.B.A.

2)Scheme B : Students who have opted for TWO papers at F.Y.B.A.

Statistics(Namely Scheme B ) continue the scheme B at S.Y.B.A. that is opt for THREE papers at S.Y.B.A.

SCHEME A

**SEMESTER III**

Course Code	UNIT	TOPICS	Credits	L / Week
UASTA 301	I	Elementary Probability Theory:	2	1
	II	Concept of Discrete random variable and properties of its probability distribution		1
	III	Some Standard Discrete Distributions		1
UASTA 302	I	Linear Programming Problem (L.P.P.)	2	1
	II	Transportation Model		1
	III	Assignment model and Sequencing		1
UASTAP3	Practicals based on both courses in theory		2	6

### SEMESTER IV

Course Code	UNIT	TOPICS	Credits	L / Week
UASTA401	I	Continuous random variable	2	1
	II	Some Standard Continuous Distributions		1
	III	Elementary topics on Estimation and Testing of hypothesis		1
UASTA402	I	Network Analysis	2	1
	II	Sampling		1
	III	Time Series		1
UASTAP4	Practicals based on both courses in theory		2	6

### SEMESTER III

Course Code	Title	Credits
UASTA301	STATISTICAL METHODS-1	2 Credits (45 lectures )
<p><b>Unit I: <u>Elementary Probability Theory:</u></b>            Trial, random experiment, sample point and sample space.            Definition of an event. Operation of events, mutually exclusive and exhaustive events.            Classical (Mathematical) and Empirical definitions of Probability, and their limitations.            Theorems on Addition and Multiplication of probabilities.            Independence of events, Conditional probability, Bayes' theorem and its applications.</p>		15 Lectures
<p><b>Unit II : <u>Concept of Discrete random variable and properties of its probability distribution:</u></b>            Random variable. Definition and properties of probability distribution and cumulative distribution function of discrete random variable.            Raw and Central moments (definition only) and their relationship. (upto order four).            Concepts of Skewness and Kurtosis and their uses.            Expectation of a random variable. Theorems on Expectation and Variance.            Joint probability mass function of two discrete random variables.            Marginal and conditional distributions. Theorems on Expectation, Variance, Covariance and Coefficient of Correlation. Independence of two random variables.</p>		15 Lectures

<p><b>Unit III : <u>Some Standard Discrete Distributions:</u></b>  Discrete Uniform, Binomial and Poisson distributions and derivation of their mean and variance.  Recurrence relation for probabilities of Binomial and Poisson distributions And its applications.  Poisson approximation to Binomial distribution (Statement only).</p>	<b>15 Lectures</b>
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**REFERENCES .**

1. Medhi J. : Statistical Methods, An Introductory Text, Second Edition, New Age International Ltd.
- 2 Agarwal B.L. : Basic Statistics, New Age International Ltd.
3. Spiegel M.R. : Theory and Problems of Statistics, Schaum’ s Publications series. Tata McGraw-Hill.
4. David S. : Elementary Probability, Cambridge University Press.
5. Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House.
6. Hogg R.V. and Tannis E.P. : Probability and Statistical Inference. McMillan Publishing Co. Inc.
7. PitanJim : Probability, Narosa Publishing House.
8. Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II : The World Press Private Limited, Calcutta.

Course Code	Title	Credits
<b>UASTA 302</b>	<b>OPERATIONS RESEARCH AND INDUSTRIAL STATISTICS-1</b>	<b>2 Credits (45 lectures )</b>
<p><b>Unit I : <u>Linear Programming Problem (L.P.P.) :</u></b>  Definition, Mathematical Formulation( Maximization and Minimization) Concepts of Solution, Feasible Solution, Basic Feasible Solution, Optimal solution, Slack, Surplus &amp; Artificial variable.  Standard form, Canonical form  Graphical Method &amp; Simplex Algorithm to obtain the solution to an L.P.P. Problems involving Unique Solution, Multiple Solution, Unbounded Solution and Infeasible Solution.  Big M method.  Concept of Duality &amp; its economic interpretation .</p>		<b>15 Lectures</b>
<p><b>Unit II : <u>Transportation Model</u></b>  Definition, Mathematical Formulation Concepts of Feasible solution, Basic feasible solution, Optimal and multiple solutions.  Initial Basic Feasible Solution using  (i) North-West Corner rule.(ii) Matrix Minima Method.  (iii)Vogel’s Approximation Method.  MODI Method for optimality.  Problems involving unique solution, multiple solutions, degeneracy, maximization, prohibited route(s) and production costs. Unbalanced Transportation problem.</p>		<b>15 Lectures</b>

**Unit III : Assignment model**

Definition, Mathematical formulation. Solution by Hungarian Method.  
 Unbalanced Assignment problems.  
 Problems involving Maximization & prohibited assignments

**15 Lectures****Sequencing :**

Processing n Jobs through 2 and 3 Machines and 2 jobs through m Machines.

**REFERENCES**

1. Operations Research: Kantiswaroop and Manmohan Gupta. 4<sup>th</sup> Edition; S Chand & Sons.
2. Schaum Series book in O.R. Richard Broson. 2<sup>nd</sup> edition Tata McGraw Hill Publishing Company Ltd.
3. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman,(1959), John Wiley & Sons.
4. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
5. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2<sup>nd</sup> Edition, Prentice Hall of India Ltd.
6. Operations Research: S.D.Sharma. 11<sup>th</sup> edition, KedarNath Ram Nath& Company.
7. Operations Research: H. A.Taha.6<sup>th</sup> edition, Prentice Hall of India.
8. Quantitative Techniques For Managerial Decisions: J.K.Sharma , (2001), MacMillan India Ltd.

**DISTRIBUTION OF TOPICS FOR PRACTICALS****SEMESTER-III****COURSE CODE UASTAP3 2 Credits**

<b>Sr. No</b>	<b>Course UASTAP3(A)</b>	<b>Course UASTAP3(B)</b>
1	Probability.	Formulation and Graphical Method
2	Discrete Random Variable	Simplex Method
3	Bivariate Probability Distributions	Transportation
4	Binomial distribution	Assignment
5	Poisson distribution	Sequencing

## SEMESTER IV

Course Code	Title	Credits
<b>UASTA 401</b>	<b>STATISTICAL METHODS-2</b>	<b>2 Credits (45 lectures )</b>
<p><b>Unit I : <u>Continuous random variable:</u></b></p> <p>Concept of Continuous random variable and properties of its probability distribution Probability density function and cumulative distribution function. Their graphical representation. Expectation of a random variable and its properties. Measures of location, dispersion, skewness and kurtosis. Raw and central moments (simple illustrations).</p>		<b>15 Lectures</b>
<p><b>Unit II : <u>Some Standard Continuous Distributions :</u></b></p> <p>Uniform, Exponential (single or double parameter) and Normal distribution. Derivations of mean, median and variance for Uniform and Exponential distributions. Properties of Normal distribution and Normal curve (without proof). Normal approximation to Binomial and Poisson distribution (statement only). Use of normal tables.</p>		<b>15 Lectures</b>
<p><b>Unit III : <u>Elementary topics on Estimation and Testing of hypothesis:</u></b></p> <p>Sample from a distribution : Concept of a statistic, estimate, sampling distribution, Parameter and its estimator. Concept of bias and standard error of an estimator. Central Limit theorem (statement only). Sampling distribution of sample means and sample proportion. (For large sample only) Standard errors of sample mean and sample proportion. Point estimate of single mean, single proportion from sample of large size. <b>Statistical tests :</b> Concept of hypothesis Null and alternate hypothesis, Types of errors, Critical region, Level of significance. Large sample tests (using central limit theorem, if necessary) For testing specified value of population mean For testing specified value in difference of two means For testing specified value of population proportion For testing specified value of difference of population proportion (Development of critical region is not expected.) Use of central limit theorem. <b>Test of goodness of fit using Chi-square distribution. ( Binomial, Poisson distributions only)</b></p>		<b>15 Lectures</b>

**REFERENCES:**

1. Introduction to the theory of statistics: A M Mood, F.A. Graybill, D C Boyes; Third Edition; McGraw-Hill Book Company.
2. Introduction to Mathematical Statistics: R.V.Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers.
3. Probability and Statistical Inference: R.V.Hogg, E. A.Tannis, Third Edition; Collier McMillan Publishers.

4. John E. Freund's Mathematical Statistics: I. Miller, M. Miller; Sixth Edition; Pearson Education Inc.
5. Introduction to Mathematical Statistics: P.G. Hoel; Fourth Edition; John Wiley & Sons Inc.
6. Fundamentals of Mathematical Statistics: S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.
7. Mathematical Statistics: J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.
8. Statistical Methods- An Introductory Text: J. Medhi; Second edition; Wiley Eastern Ltd.
9. An Outline of Statistical Theory Vol. 1: A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; The World Press Pvt. Ltd.

Course Code	Title	Credits
<b>UASTA 402</b>	<b>OPERATIONS RESEARCH AND INDUSTRIAL STATISTICS-2</b>	<b>2 Credits (45 lectures )</b>
<p><b><u>Unit I : Network Analysis</u></b>            Concept of project as an organized effort with time management.            Objective and Outline of the techniques.            Diagrammatic representation of activities in a project            Bar Diagram and Network Diagram.            Slack time and Float times. Determination of Critical path.            Probability consideration in project scheduling.</p>		<b>15 Lectures</b>
<p><b><u>Unit II :Sampling:</u></b>            Concepts of population, population unit, sample, sample size, parameter, statistic, estimator, unbiasedness, bias, mean square error (M.S.E.) and standard error.            Census and Sample Surveys:            Steps in conducting sample survey            Designing a Questionnaire.            Concepts of Sampling errors and Non-sampling errors.            Concepts of non-probability sampling and probability sampling.            Sampling with replacement: Sampling without replacement.            Simple random sample ( SRS )            Drawing Simple random sample ( SRS) using            (a) Lottery Method and            (b) Random numbers            Estimation of Population mean            Introduction to: Stratified sampling, Systematic sampling, Cluster sampling, Two stage sampling.            Application to Market Research in various fields.            NSSO, CSO and their functions.</p>		<b>15 Lectures</b>
<p><b><u>Unit III : TIME SERIES :</u></b>            Definition of a time series. Its components. Models of time series. Estimation of trend by (i) freehand curve method (ii) method of semi-averages (iii) method of moving averages, (iv) method of least-squares.            Estimation of seasonal component by (i) method of simple averages (ii) ratio-to-moving average method (iii) ratio to trend method (iv) method of link relatives            Exponential smoothing method and its applications.</p>		<b>15 Lectures</b>

## REFERENCES

1. Experimental Designs: W.G. Cochran and G.M.Cox; Second Edition; John Wiley and Sons.
2. Fundamentals of Applied Statistics: S.C.Gupta and V.K.Kapoor; 3<sup>rd</sup> Edition; Sultan Chand and Sons (2001).
3. Operations Research: Kantiswaroop and Manmohan Gupta. 4<sup>th</sup> Edition; S Chand & Sons.
4. Schaum Series book in O.R. Richard Broson. 2<sup>nd</sup> edition Tata Mcgraw Hill Publishing Company Ltd.
5. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman,(1959), John Wiley & Sons.
6. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
7. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2<sup>nd</sup> Edition, Prentice Hall of India Ltd.
8. Operations Research: S.D.Sharma. 11<sup>th</sup> edition, KedarNath Ram Nath& Company.
9. Operations Research: H. A.Taha. 6<sup>th</sup> edition, Prentice Hall of India.
10. PERT and CPM, Principles and Applications: Srinath. 2<sup>nd</sup> edition, East-west press Pvt. Ltd.

## DISTRIBUTION OF TOPICS FOR PRACTICALS

### SEMESTER-IV

#### COURSE CODE UASTP4      2 Credits

Sr. No	Course UASTAP4(A)	Course UASTAP4(B)	
1	Continuous Random Variables	CPM- Drawing Network	
2	Uniform, Exponential and Normal Distributions	CPM- Determination of Critical Path and related problems	
3	Applications of central limit theorem and normal approximation	PERT	
4	Testing of Hypothesis	Sampling	
5	Large Sample Tests	Time Series	

#### Internal Assessment of Theory Core Courses Per Semester Per Course

1. Two Assignments: ..... 10 Marks **each.**
2. One Class Test: ..... 10 Marks.
3. Active participation in class instructional deliveries:..... 05 Marks.
4. Overall conduct as a responsible student, mannerism etc :.... .05 Marks.

#### Internal Assessment of Practical Core Courses Per Semester per course

1. Semester work, Documentation, Journal ..... 05 Marks.



2. Viva: .....05 Marks.
3. For any one or the combinations of the following activities..... 10 Marks.
  - Data collection and /or analysis.
  - Assignments with any soft ware package.
  - Case study/project.
  - Seminar based on any topic preferably not covered in syllabus.
  - Industrial visit and its report.

### **Semester End Examination**

**Theory**: At the end of the semester, examination of two hours duration and 60 marks based on the three units shall be held for each course.

Pattern of **Theory question** paper at the end of the semester for **each course** :

There shall be Four Questions of fifteen marks each. All Questions Should be Compulsory. Question1 based on Unit I, Question 2 based on Unit II, Question 3 based on Unit III, Question4 based on all Three Units combined.

Each question will have sub questions as given below:

- Attempt any ONE Out of Two questions carrying 1 Mark each.
- Attempt any TWO Out of Three questions carrying 7 Marks each.

**Practicals**: At the end of the semester, examination of 1 ½ hours duration and 30 marks shall be held for **each course**.

Pattern of **Practical question** paper at the end of the semester for **each course** :

There shall be Four Questions of ten marks each. Students should attempt **any three** out of the four Questions.

Question1 based on Unit I, Question 2 based on Unit II, Question 3 based on Unit III, Question4 based on all Three Units combined.

### **Workload**

**Theory** :3 lectures per week per course.

**Practicals**: 3 lecture periods per course per week per batch. All three lecture periods of the practicals shall be conducted in succession together on a single day

## SCHEME B

1) Those students who have opted this scheme for Statistics at S.Y.B.A. will have THREE papers in Statistics and they should choose ONE paper out of remaining TWO compulsory papers.

2) These students of S.Y.B.A. will have teaching and evaluation along with the corresponding S.Y. B. Sc students of Statistics.

The course codes and evaluation for those S.Y.B.A. ( Statistics ) Scheme B will be as mentioned below.

### SEMESTER III

Course Code	UNIT	TOPICS	Credits	L / Week
USSTB301	I	Univariate Random Variables. (Discrete and Continuous)	2	1
	II	Standard Discrete Probability Distributions.		1
	III	Bivariate Probability Distributions.		1
USSTB302	I	Concepts of Sampling and Simple Random Sampling.	2	1
	II	Stratified Sampling.		1
	III	Ratio and Regression Estimation.		1
USSTB303	I	Linear Programming Problem.	2	1
	II	Transportation Problem.		1
	III	Assignment & Sequencing Problem.		1
USSTBP3	Practicals based on all courses in theory		3	9

**SEMESTER IV**

Course Code	UNIT	TOPICS	Credits	L / Week
USSTB401	I	Standard Continuous Probability Distributions.	2	1
	II	Normal Distribution.		1
	III	Exact Sampling Distributions.		1
USSTB402	I	Analysis of Variance.	2	1
	II	Design Of Experiments, Completely Randomized design & Randomized Block Design.		1
	III	Latin Square Design & Factorial Experiments.		1
USSTB403	I	CPM and PERT.	2	1
	II	Control charts.		1
	III	Lot Acceptance Sampling Plans By Attributes.		1
USSTBP4	Practicals based on all courses in theory		3	9

Course Code	Title	Credits
USSTB301	<b><u>PROBABILITY DISTRIBUTIONS</u></b>	<b>2 Credits (45 lectures )</b>
<b>Unit I : Univariate Random Variables (Discrete and Continuous):</b> Moment Generating Function, Cumulant generating Function-Their important properties. Relationship between moments and cumulants and their uses. Characteristic Function- Its properties (without proof). Transformation of random Variable		<b>15 Lectures</b>
<b>Unit II :Standard Discrete Probability Distributions:</b> Uniform, Bernoulli, Binomial, Poisson, Geometric, Negative Binomial & Hypergeometric distributions. The following aspects of the above distributions (wherever applicable) to be discussed: Mean, Mode and Standard deviation. Moment Generating Function, Cumulant Generating Function, Additive property, Recurrence relation for central Moments, Skewness and Kurtosis (without proof), Limiting distribution. Fitting of Distribution. Truncated Binomial and Truncated Poisson Distribution: Suitable illustrations, probability mass function, mean.		<b>15 Lectures</b>
<b>Unit III : Bivariate Probability Distributions:</b> Joint Probability mass function for Discrete random variables, Joint Probability density function for continuous random variables. Their properties. Marginal and conditional Distributions. Independence of Random Variables. Conditional		<b>15 Lectures</b>

Expectation & Variance. Regression Function. Coefficient of Correlation. Transformation of Random Variables and Jacobian of transformation with illustrations.

**REFERENCES:**

1. Introduction to the theory of statistics: A. M. Mood, F.A. Graybill, D. C. Boyes, Third Edition; McGraw-Hill Book Company.
2. Introduction to Mathematical Statistics: R.V.Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers.
3. Probability and Statistical Inference: R.V.Hogg, E. A.Tannis, Third Edition; Collier McMillan Publishers.
4. John E. Freund's Mathematical Statistics: I. Miller, M. Miller; Sixth Edition; Pearson Education Inc.
5. Introduction to Mathematical Statistics: P.G. Hoel; Fourth Edition; John Wiley & Sons Inc.
6. Fundamentals of Mathematical Statistics: S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.
7. Mathematical Statistics: J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.
8. Statistical Methods: An Introductory Text: J. Medhi; Second edition; Wiley Eastern Ltd.
9. An Outline of Statistical Theory Vol. 1: A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; The World Press Pvt. Ltd.
10. Statistical Methods Using R Software :V. R. Pawagi and Saroj A. Ranade ;Nirali Publications.
11. Statistics Using R.S. G. Purohit, S. D. Gore, and S. R. Deshmukh.Narosa Publishing House.

Course Code	Title	Credits
<b>USSTB302</b>	<b><u>THEORY OF SAMPLING</u></b>	<b>2 Credits (45 lectures )</b>
<p><b>Unit I : Concepts:</b>            Population, Population unit, Sample, Sample unit, Parameter, Statistic, Estimator, Bias, Unbiasedness, Mean square error &amp; Standard error.            Census survey, Sample Survey. Steps in conducting a sample survey with examples on designing appropriate Questionnaire. Concepts of Sampling and Non-sampling errors. NSSO, CSO and their functions.            Concepts and methods of Probability and Non Probability sampling.  <b>Simple Random Sampling:(SRS).</b>            Definition, Sampling with &amp; without replacement (WR/WOR).            Lottery method &amp; use of Random numbers to select Simple random sample.            Estimation of population mean &amp; total. Expectation &amp; Variance of the estimators, Unbiased estimator of variance of these estimators. (WR/WOR).            Estimation of population proportion. Expectation &amp; Variance of the estimators, Unbiased estimator of variance of these estimators. (WR/WOR).            Estimation of Sample size based on a desired accuracy in case of SRS for variables &amp; attributes. (WR/WOR).</p>		<b>15 Lectures</b>

<p><b>Unit II : Stratified Sampling:</b> Need for Stratification of population with suitable examples. Definition of Stratified Sample. Advantages of stratified Sampling. <b>Stratified Random Sampling:</b> Estimation of population mean &amp; total in case of Stratified Random Sampling (WOR within each strata). Expectation &amp; Variance of the unbiased estimators, Unbiased estimators of variances of these estimators. Proportional allocation, Optimum allocation with and without varying costs. Comparison of Simple Random Sampling, Stratified Random Sampling using Proportional allocation &amp; Neyman allocation.</p>	<b>15 Lectures</b>
<p><b>Unit III : a. Ratio &amp; Regression Estimation assuming SRSWOR:</b> Ratio Estimators for population Ratio, Mean &amp; Total. Expectation &amp; MSE of the Estimators. Estimators of MSE. Uses of Ratio Estimator. Regression Estimators for population Mean &amp; Total. Expectation &amp; Variance of the Estimators assuming known value of regression coefficient 'b'. Estimation of 'b'. Resulting variance of the estimators. Uses of regression Estimator. Comparison of Ratio, Regression &amp; mean per Unit estimators. <b>b. Introduction to Systematic sampling, Cluster sampling &amp; Two Stage sampling with suitable illustrations.</b></p>	<b>15 Lectures</b>

**REFERENCES:**

1. Sampling Techniques: W.G. Cochran; 3<sup>rd</sup> Edition; Wiley(1978)
2. Sampling Theory and methods: M.N. Murthy; Statistical Publishing Society. (1967)
3. Sampling Theory: Des Raj; McGraw Hill Series in Probability and Statistics. (1968).
4. Sampling Theory of Surveys with Applications: P.V. Sukhatme and B.V. Sukhatme; 3<sup>rd</sup> Edition; Iowa State University Press (1984).
5. Fundamentals of Applied Statistics: S. C. Gupta and V.K. Kapoor; 3<sup>rd</sup> Edition; Sultan Chand and Sons (2001).
6. Theory and Analysis of Sample Survey Designs: Daroga Singh, F.S. Chaudhary, Wiley Eastern Ltd. (1986).
7. Sampling Theory and Methods: S. Sampath, Second Edition (2005), Narosa.
8. Theory and Methods of Survey Sampling: Parimal Mukhopadhyay, (1998), Prentice Hall Of India Pvt. Ltd.

Course Code	Title	Credits
<b>USSTB303</b>	<b><u>OPERATIONS RESEARCH</u></b>	<b>2 Credits (45 lectures )</b>
<p><b>Unit I : Linear Programming Problem (L.P.P.) :</b> Mathematical Formulation: Maximization &amp; Minimization. Concepts of Solution, Feasible Solution, Basic Feasible Solution, Optimal solution. Graphical Solution for problems with two variables. Simplex method of solving problems with two or more variables. Big M method. Concept of Duality. Its use in solving L.P.P. Relationship between optimum solutions to Primal and Dual. Economic interpretation of Dual.</p>		<b>15 Lectures</b>
<p><b>Unit II : Transportation Problem:</b> Concept, Mathematical Formulation. Concepts of Solution, Feasible Solution. Initial Basic Feasible Solution by North-West Corner Rule, Matrix Minima Method, Vogel's Approximation Method. Optimal Solution by MODI Method. Optimality test, Improvement procedure.</p>		<b>15 Lectures</b>

<p>Variants in Transportation Problem: Unbalanced, Maximization type.</p>	
<p><b>Unit III :Assignment Problem:</b>          Concept. Mathematical Formulation          Solution by: Complete Enumeration Method and Hungarian method.          Variants in Assignment Problem: Unbalanced, Maximization type.          Travelling Salesman Problem  <u><b>Sequencing :</b></u>          Processing n Jobs through 2 and 3 Machines &amp; 2 Jobs through m Machines.</p>	<p><b>15 Lectures</b></p>

**REFERENCES**

9. Operations Research: Kantiswaroop and Manmohan Gupta. 4<sup>th</sup> Edition; S Chand & Sons.
10. Schaum Series book in O.R. Richard Broson. 2<sup>nd</sup> edition Tata Mcgraw Hill Publishing Company Ltd.
11. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman,(1959), John Wiley & Sons.
12. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
13. Principles of Operations Research with Applications to Management Decisions: Harvey M.Wagner, 2<sup>nd</sup> Edition, Prentice Hall of India Ltd.
14. Operations Research: S.D.Sharma.11<sup>th</sup> edition, KedarNath Ram Nath& Company.
15. Operations Research: H. A.Taha.6<sup>th</sup> edition, Prentice Hall of India.
16. Quantitative Techniques For Managerial Decisions: J.K.Sharma, (2001), MacMillan India Ltd.

## DISTRIBUTION OF TOPICS FOR PRACTICALS

### SEMESTER-III

#### COURSE CODE USSTP3 3 Credits

<b>Sr. No</b>	<b>.Course USSTBP3(A)</b>
1	Moment Generating Function, Moments.
2	Cumulant generating Function, Cumulants, Characteristic function.
3	Standard Discrete Distributions.
4	Fitting Standard Discrete Distributions.
5	Bivariate Probability Distributions, Marginal & Conditional distributions, Conditional Mean, Conditional Variance, Correlation.
6	Transformation of discrete & continuous random variables.
7	Applications of R.

<b>Sr. No</b>	<b>Course USSTBP3(B)</b>
1	Designing of Questionnaire.
2	Simple Random Sampling for Variables.
3	Simple Random Sampling for Attributes.
4	Estimation of Sample Size in Simple Random Sampling.
5	Stratified Random Sampling.
6	Ratio Estimation.
7	Regression Estimation.

<b>Sr. No</b>	<b>Course USSTPB3(C)</b>
1	Formulation and Graphical Solution of L.P.P.
2	Simplex Method.
3	Duality.
4	Transportation.
5	Assignment.
6	Sequencing.
7	Problems solving using TORA.

Course Code	Title	Credits
<b>USSTB401</b>	<b><u>PROBABILITY AND SAMPLING DISTRIBUTIONS</u></b>	<b>2 Credits (45 lectures )</b>
<p><b>Unit I : <u>Standard Continuous Probability Distributions:</u></b>            Rectangular, Triangular, Exponential, Cauchy (with Single &amp; Double parameter), Gamma (with Single &amp; Double parameter), Beta (Type I &amp; Type II).            The following aspects of the above distributions(wherever applicable) to be discussed:            Mean, Median, Mode &amp; Standard deviation. Moment Generating Function, Additive property, Cumulant Generating Function. Skewness and Kurtosis (without proof). Fitting of Distribution. Interrelation between the distributions.</p>		<b>15 Lectures</b>
<p><b>Unit II : <u>Normal Distribution:</u></b>            Mean, Median, Mode, Standard deviation, Moment Generating function, Cumulant Generating function, Moments &amp; Cumulants (up to fourth order). Recurrence relation for central moments, skewness &amp; kurtosis, Mean absolute deviation. Distribution of linear function of independent Normal variables. Fitting of Normal Distribution. Central Limit theorem for i.i.d. random variables.            Log Normal Distribution: Derivation of mean &amp; variance.</p>		<b>15 Lectures</b>
<p><b>Unit III: <u>Exact Sampling Distributions:</u></b></p> <p><b><u>Chi-Square Distribution:</u></b> Concept of degrees of freedom. Mean, Median, Mode &amp; Standard deviation. Moment generating function, Cumulant generating function. Additive property, Distribution of the sum of squares of independent Standard Normal variables. Sampling distributions of sample mean and sample variance and their independence for a sample drawn from Normal distribution (without proof).  <b><u>Applications of Chi-Square:</u></b> Confidence interval for the variance of a Normal population, Test of significance for specified value of variance of a Normal population. Test for goodness of fit, Test for independence of attributes. Yates' correction.</p> <p><b><u>t-distribution:</u></b> Mean, Median, Mode &amp; Standard deviation. Distribution of ratio of a Standard Normal variable to the square root of an independent Chi-square divided by its degrees of freedom. Asymptotic properties. Student's t.  <b><u>Applications of t:</u></b> Confidence interval for: Mean of Normal population, difference between means of two independent Normal populations having the same variance. Test of significance of: mean of a Normal population, difference in means of two Normal populations (based on: (i) independent samples with equal variances. (ii) dependent samples).</p> <p><b><u>F-distribution:</u></b> Mean, Mode &amp; Standard deviation. Distribution of : Reciprocal of an F variate, Ratio of two independent Chi-squares divided by their respective degrees of freedom. Interrelationship of F with: t-distribution, Chi-square distribution &amp; Normal distribution.  <b><u>Applications of F:</u></b> Confidence interval for ratio of variances of two independent Normal populations. Test for equality of variances of two independent Normal populations.</p>		<b>15 Lectures</b>



**REFERENCES:**

10. Introduction to the theory of statistics: A M Mood, F.A. Graybill, D C Boyes; Third Edition; McGraw-Hill Book Company.
11. Introduction to Mathematical Statistics: R.V.Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers.
12. Probability and Statistical Inference: R.V.Hogg, E. A.Tannis, Third Edition; Collier McMillan Publishers.
13. John E. Freund's Mathematical Statistics: I. Miller, M. Miller; Sixth Edition; Pearson Education Inc.
14. Introduction to Mathematical Statistics: P.G. Hoel; Fourth Edition; John Wiley & Sons Inc.
15. Fundamentals of Mathematical Statistics: S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.
16. Mathematical Statistics: J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.
17. Statistical Methods- An Introductory Text: J. Medhi; Second edition; Wiley Eastern Ltd.
18. An Outline of Statistical Theory Vol. 1: A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; The World Press Pvt. Ltd.

Course Code	Title	Credits
<b>USSTB402</b>	<b><u>ANALYSIS OF VARIANCE &amp; DESIGN OF EXPERIMENTS</u></b>	<b>2 Credits (45 lectures )</b>
<p><b>Unit I : <u>Analysis of Variance:</u></b>            Introduction, Uses, Cochran's Theorem (Statement only).            One way classification with equal &amp; unequal observations per class, Two way classification with one observation per cell.            Mathematical Model, Assumptions, Expectation of various sums of squares, F- test, Analysis of variance table.            Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard Error and Confidence limits for elementary treatment contrasts.</p>		<b>15 Lectures</b>
<p><b>Unit II : <u>Design Of Experiments:</u></b>            Concepts of Experiments, Experimental unit, Treatment, Yield, Block, Replicate, Experimental Error, Precision. Principles of Design of Experiments: Replication, Randomization &amp; Local Control.            Efficiency of design D1 with respect to design D2.            Choice of size, shape of plots &amp; blocks in agricultural &amp; non agricultural experiments.  <b><u>Completely Randomized Design (CRD) &amp; Randomized Block Design (RBD):</u></b>            Mathematical Model, Assumptions, Expectation of various sums of squares, F-test, Analysis of variance table.            Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard error and Confidence limits for elementary treatment contrasts. Efficiency of RBD relative to a CRD.</p>		<b>15 Lectures</b>
<p><b>Unit III : <u>Latin Square Design (LSD):</u></b>            Mathematical Model, Assumptions, Expectation of various sums of squares, F-test, Analysis of variance table. Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard error and Confidence limits for elementary treatment contrasts. Efficiency of the design relative to RBD, CRD. Missing plot technique for one missing observation in case of CRD, RBD &amp; LSD.  <b><u>Factorial Experiments:</u></b>            Definition, Purpose &amp; Advantages. <math>2^2</math>, <math>2^3</math> Experiments. Calculation of Main &amp; interaction Effects. Yates' method. Analysis of <math>2^2</math> &amp; <math>2^3</math> factorial Experiments.</p>		<b>15 Lectures</b>

### **REFERENCES**

11. Experimental Designs: W.G. Cochran and G.M.Cox; Second Edition; John Wiley and Sons.
12. The Design and Analysis of Experiments: Oscar Kempthorne, John Wiley and Sons.
13. Design and Analysis of Experiments: Douglas C Montgomery; 6<sup>th</sup> Edition; John Wiley & Sons.
14. Design and Analysis of Experiments: M.N.Das and N.C.Giri, 2<sup>nd</sup> Edition; New Age International (P) Limited; 1986.
15. Experimental Design, Theory and Application: Walter T Federer; Oxford & IBH Publishing Co. Pvt. Ltd.
16. Fundamentals of Applied Statistics: S.C.Gupta and V.K.Kapoor; 3<sup>rd</sup> Edition; Sultan Chand and Sons (2001).
17. Statistical Principles in Experimental Design: B.J. Winer, McGraw Hill Book Company.

Course Code	Title	Credits
<b>USSTB403</b>	<b><u>PROJECT MANAGEMENT AND INDUSTRIAL STATISTICS</u></b>	<b>2 Credits (45 lectures )</b>
<b>Unit I : <u>CPM and PERT:</u></b> Objective and Outline of the techniques. Diagrammatic representation of activities in a project: Gantt Chart and Network Diagram. Slack time and Float times. Determination of Critical path. Probability consideration in project scheduling. Project cost analysis. Updating.		<b>15 Lectures</b>
<b>Unit II : <u>Control Charts :</u></b> Principles of control. Process quality control of attributes and variables. $\bar{X}$ , R, p, c, np charts, their uses. p-chart with variable sample size. Problems involving setting up standards for future use.		<b>15 Lectures</b>
<b>Unit III : <u>Lot Acceptance Sampling Plans by Attributes:</u></b> Single Sampling Plans (without curtailment). OC function and OC curves. AQL, LTPD, ASN, ATI, AOQ, Consumer's risk, Producer's risk. Double Sampling Plan (without curtailment). OC function and OC curves. Introduction to Six sigma limits.		<b>15 Lectures</b>

### **REFERENCES**

1. Statistical Quality Control: E.L.Grant. 2<sup>nd</sup> edition, McGraw Hill, 1988.
2. Quality Control and Industrial Statistics: Duncan. 3<sup>rd</sup> edition, D.Taraporewala sons & company.
3. Quality Control: Theory and Applications: Bertrand L. Hansen, (1973),Prentice Hall of India Pvt. Ltd..
4. Quality Control: I.V. Burr, Mardekkar, New York, 1976.
5. PERT and CPM, Principles and Applications: Srinath. 2<sup>nd</sup> edition, East-west press Pvt. Ltd.
6. Operations Research: Kantiswaroop and Manmohan Gupta. 4<sup>th</sup> Edition; S Chand & Sons.
7. Schaum Series book in O.R. Richard Broson. 2<sup>nd</sup> edition Tata McGraw Hill Publishing Company Ltd.
8. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman,(1959), John Wiley & Sons.
9. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
10. Operations Research: S.D.Sharma.11<sup>th</sup> edition, KedarNath Ram Nath& Company.
11. Operations Research: H. A.Taha., 6<sup>th</sup> edition, Prentice Hall of India.
12. Quantitative Techniques For Managerial Decisions: J.K.Sharma, (2001), MacMillan India Ltd.

**DISTRIBUTION OF TOPICS FOR PRACTICALS**

**SEMESTER-IV**  
**COURSE CODE USSTP4 3 Credits**

<b>Sr. No</b>	<b>Course USSTBP4(A)</b>
1	Standard Continuous distributions.
2	Normal Distribution.
3	Central Limit Theorem.
4	Chi Square distribution.
5	t distribution.
6	F distribution.
7	Application of R.

<b>Sr. No</b>	<b>Course USSTBP4(B)</b>
1	Analysis of Variance- One Way.
2	Analysis of Variance- Two Way.
3	Completely Randomized Design.
4	Randomized Block Design.
5	Latin Square Design.
6	Missing Observations in CRD, RBD & LSD.
7	Factorial Experiments.

<b>Sr. No</b>	<b>Course USSTBP4(C)</b>
1	CPM-PERT : Construction of Network.
2	Finding Critical Path. Computing Probability of Project completion.
3	Project cost analysis.
4	Updating.
5	Control Charts for attributes.
6	Control Charts for variables.
7	Acceptance Sampling Plans.

### **Internal Assessment of Theory Core Courses Per Semester Per Course**

5. Two Assignments: ..... 10 Marks **each.**
6. One Class Test: .....10 Marks.
7. Active participation in class instructional deliveries:.....05 Marks.
8. Overall conduct as a responsible student, mannerism etc:.... .05 Marks.

### **Internal Assessment of Practical Core Courses Per Semester per course**

1. Semester work, Documentation, Journal.....05Marks.
2. Viva: .....05 Marks.
3. For any one or the combinations of the following activities.....10 Marks.
  - Data collection and /or analysis.
  - Assignments using R software/ TORA software/other statistical soft ware package.
  - Case study/project.
  - Seminar based on any topic preferably not covered in syllabus.
  - Industrial visit and its report.

### **Semester End Examination**

**Theory:** At the end of the semester, examination of two hours duration and 60 marks based on the three units shall be held for each course.

Pattern of **Theory question** paper at the end of the semester for **each course** :

There shall be Four Questions of fifteen marks each. All Questions Should be Compulsory. Question1 based on Unit I, Question 2 based on Unit II, Question 3 based on Unit III, Question4 based on all Three Units combined.

Each question will have sub questions as given below:

- Attempt any ONE Out of Two questions carrying 1 Mark each.
- Attempt any TWO Out of Three questions carrying 7 Marks each.

**Practicals:** At the end of the semester, examination of 1 ½ hours duration and 30 marks shall be held for **each course**.

Pattern of **Practical question** paper at the end of the semester for **each course** :

There shall be Four Questions of ten marks each. Students should attempt **any three** out of the four Questions.

Question1 based on Unit I, Question 2 based on Unit II, Question 3 based on Unit III, Question4 based on all Three Units combined.

### **Workload**

**Theory** :3 lectures per week per course.

**Practicals:** 3 lecture periods per course per week per batch. All three lecture periods of the practicals shall be conducted in succession together on a single day

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