

Tribhuvan University
Institute of Science & Technology

Level: B.Sc.

Year: III

Course Title: Probability and Inference-II

Course Code: STA 301

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 35

Total Number of Periods: 150

Course objectives: To impart theoretical and applied knowledge in probability distributions; convergence, inequalities and limit theorems; and statistical inference including decision theory and sequential analysis

Group A

1. Continuous Distributions: [30]

- Logistic distribution: PDF, CDF, standard logistic distribution, MGF, properties and uses, distribution fitting
- Lognormal distribution: PDF, CDF, MGF (does not exist for whole range), properties and uses, distribution fitting
- Weibull distribution: PDF, CDF, MGF, CF, moments, properties and uses
- Inverse uniform, Inverse gamma, inverse chi-square distribution (concept and applications only)
- Problems and illustrative examples

2. Truncated Distributions: [20]

- Meaning of truncation, left, right and doubly truncations, truncated probability distributions: Binomial (with derivation), Poisson (with derivation), normal distributions (without derivation): their mass/density functions, moments, distribution fittings
- Problems and illustrative examples

3 Convergence, Inequalities and Limit Theorems [25]

- **Convergence:** Modes of convergence, convergence in probability, convergence in r^{th} mean, convergence in distribution and almost sure convergence
- **Inequalities:** Chebyshev, Minkowsky, Holder, Cauchy-Schwartz, Markov and Kolmogorov

- **Limit Theorems:** Law of large numbers: weak law of large numbers and Khinchine's theorem, strong law of large numbers (statement only) and Kolmogorov's theorem, central limit theorem for independently and identically distributed random variables (Lindeberg-Levy)
- Problems and illustrative examples

Group B

4. Testing of Hypothesis

[20]

- Uniformly most Powerful (UMP) test
- Uniformly Most Powerful (UMP) test via Neyman Pearson's Lemma
- Monotonic likelihood ratio properties
- Likelihood Ratio (LR) test, one sample problem, likelihood ratio test for mean in a normal population when variance is known and variance is unknown
- Likelihood ratio test for the variance of a normal population
- Properties of likelihood ratio test
- Problems and illustrative examples

5. Decision Theory

[30]

- Basic idea on decision theory
- Essential elements of decision making environment
- Loss function, risk function, minimax, maximax and maximin decision rule
- Prior and posterior distributions, Bayes risk, simple problems based on Bayes estimation and testing of hypothesis
- Problems and illustrative examples

6. Sequential Analysis

[25]

- Sequential Probability Ratio Test (SPRT): Definition, derivation of SPRT for testing parameters of binomial and normal distributions, properties of SPRT
- Fundamental identity of Wald's operating characteristic (OC) and average sample number (ASN) functions, or sequential estimation, graphical procedure in sequential tests
- Problems and illustrative examples

References:

1. Rohatgi V. K. and Ehsanes Saleh, A. K. MD (2005). *An Introduction to Probability and Statistics*, John Wiley & Sons
2. Shrestha H. B. (2006). *Statistics and Probability: Concepts and Techniques*, Second Edition, EKTA Books
3. Gupta S. C. and Kapoor V. K. (2007). *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons.
4. Mayer, P. L. (1970). *Introductory Probability and Statistical Applications*, second edition, Oxford and IBH Publishing Co. Pvt Ltd, New Delhi.
5. Shrestha, H.B., *Statistical Inference*, Ekta Books, Latest Edition
6. Rohatgi, V. K. (1984). *Statistical Inference*, Wiley, New York.
7. Hogg R.V and Criag, A.T. *Introduction to mathematical statistics*, 3rd edition, Academic Press, USA
8. Kale, B.K (1999). *A First course of Parametric Inference*, Narosa Publishing House
9. Wald, A.(1982). *Sequential Analysis*, John Wiley, New york
10. H.J Larson, *Introduction to Probability theory and Statistical Inference*, Wiley International Edition, N.Y.
11. Nitis Mukhopadhyay (2000). *Probability and Statistical Inference*, CRC Press Taylor & Francis Group

**Tribhuvan University
Institute of Science & Technology**

Level: B.Sc.

Year: III

Course Title: Probability and Inference-II

Course Code: STA 302

Nature of the Course: Practical

Full Marks: 50

Pass Marks: 20

Total Number of Periods: 180

Pre-requisites: Sound knowledge in the topics of Probability and Inference-II

Course objectives:

- To develop computational skills in probability and inference.
- To understand and apply theoretical knowledge in practical and numerical problems and thus relate theory with practice confidently.

Title of the practical problems

| S. No. | Title of the practical problem | No. of problems |
|--------|---|-----------------|
| 1 | Continuous probability distributions (Logistic, lognormal and weibul) | 4 |
| 2 | Truncated distributions (left and right truncation, Poisson and normal) | 4 |
| 3 | Convergence and Limit Theorems (Law of large numbers, inequalities and central limit theorem) | 5 |
| 4 | Problems in testing of hypothesis | 4 |
| 5 | Loss function, risk function and decision criteria | 2 |
| 6 | Prior and posterior distributions, Bayesian estimation and testing of hypothesis | 2 |
| 7 | Sequential probability ratio test | 2 |
| 8 | Operating characteristic curve and average sample number | 2 |
| | Total number of practical problems | 25 |

Tribhuvan University
Institute of Science & Technology

Level: B.Sc.

Year: III

Course Title: Economic Statistics (Elective Course)

Course Code: STA 303

Nature of the Course: Theory

Full Marks: 50

Pass Marks: 17.5

Total Number of Periods: 75

Course objectives:

After the completion of this course students will be able to i) to understand the knowledge about the economic indicators and their computation and ii) to have the knowledge of Index number and Time Series Analysis and their applications.

A. Development Economics and Economic Measures

[50]

- **Concept of Statistics in Economics.** Definition of some useful economic terms: micro & macroeconomics, demand & supply, consumption, value added, trade, labor force, output, shadow price, opportunity cost.
- **Development Indices & their components:** Human Development Index (HDI), Gender Development Index GDI, Human Poverty Index HPI. Millennium Development Goal.
- **System of National Account:** accounting systems (current, accumulation & Balance Sheet), Gross Development Production (GDP), GDP deflator & calculation of growth rate, ISIC classification. Primary, secondary & tertiary sector. Gross National Income (GNI). Gross National Expenditure, Capital stock and National wealth, nominal and real values.
- **Estimation of National Income:** Product Approach, Income Approach, Expenditure Approach.
- **Consumption:** consumption quintiles & per capita consumption, consumption basket and approaches, calculation of CPI and use.
- **Income Inequality & Poverty measures:** concept, calculation of Gini Coefficient, Poverty Line, Poverty Gap, Intensity of Poverty, Combined Measures. Concept of social welfare-Kakwani's, Theil's & Sen's index.
- Numerical exercises

B. Index Numbers

[10]

- Introduction, definition and meaning
- Points to be considered in construction of index numbers.

- Simple and weighted index numbers.
- Laspeyre's, Passche's and Fisher's index numbers.
- Time reversal test and factor reversal test
- Cost of living index number
- Base shifting, inflation and deflation
- Description of the Nepalese Economics Data produced by Nepal Rastra Bank, Central Bureau of Statistics (CBS), Finance Ministry.
- Numerical exercises

C. Time Series Analysis

[15]

- Introduction, definition and meaning
- Importance of time series analysis in economics data
- Components of time series: (i) secular trend (ii) short term fluctuations seasonal variation and cyclic variation (iii) random or irregular movement
- Mathematical models for time series: Additive and multiplicative models, methods of measuring trend: (i) graphic method, (ii) semi average method (iii) moving average method, (iv) least square method; prediction using least square method using linear trend
- Measurement of seasonal variation: (i) method of simple average (ii) ratio to trend method (iii) ratio to moving average method (iv) link relative method
- Deseasonalizing the time series data (description and computation), measurement of cyclic fluctuation
- Numerical exercises

References:

1. Enrico Giovanini (2008). *Understanding Economic Statistics*, OECD press (<http://www.oecd.org/statistics/understandingeconomicstatistics>)
2. *Economic Survey*, Ministry of Finance, Nepal
3. केन्द्रीयतथ्यांक विभाग(२०६६): नेपालमा आधिकारिक तथ्यांक प्रणाली तथा विधि (System and Methods of Official Statistics in Nepal).
4. UNDP, *Human Development Report (HDR)*.
5. UNDP, *Nepal Human Development Report (NHDR)*.
6. Joseph E. Stiglitz and Carl E. Walsh(2007), *Economics*, W.W. Norton & Company, Inc., NewYork, International Student Edition, 4th edition
7. Aman ULLAH, & David E A. GILES (1998), *Applied Economic Statistics*, Eastern Hemisphere Distributions
8. Ray, Devraj (1998). *Development Economics*, Oxford University Press
9. Sen, Amartya (1997). *Poverty and Inequality*, Oxford University Press
10. Foster, James E. and Sen, A. (1973). *On Economic Inequality*, Oxford University Press.

11. Gupta, S. C. and Kapoor V. K. (Latest Ed.). *Fundamentals of Applied Statistics*, Sultan Chand and Sons.

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| Tribhuvan University Institute of Science & Technology | |
| Level: B.Sc. | |
| Year: III | |
| Course Title: Operations Research (Elective Course for Statistics) | |
| Course Code: STA 304 | Full Marks: 50 |
| Nature of the Course: Theory | Pass Marks: 17.5 |
| | Total Number of Periods: 75 |

Course objectives:

To acquaint students with skills of operations research in the analysis of market and financial problems

1. Introduction **[5]**

History, development, objectives, scope, nature and definition, characteristics, scientific method, limitations of operations research, types of mathematical models.

2. Linear Programming Problem(LPP) **[20]**

Concept of LPP, application of LPP using Simplex method, including Duality; Transportation and Assignment Problems

3. Network Analysis **[15]**

Introduction of network analysis, terminologies, construction network, Network analysis Method PERT, CPM networks, time estimates, determination of critical path, determination of float, resource analysis and allocation, probability estimates, time chart, shortest route technique
Examples and problems

4. Inventory Management **[25]**

Types of inventories: Movement inventories, buffer inventories, anticipation inventories, decoupling inventories, cycle inventories
Inventory decisions

Inventory costs: Purchase cost, ordering/set-up cost, carrying cost, stockout cost
Inventory management systems: Fixed order quantity system, periodic review system
Classical economic order quantity (EOQ) model, assumptions and robustness of the EOQ model, EOQ with price breaks, EOQ model for production runs, inventory models with planned shortages, determination of safety stock
Different Methods (Approaches) to inventory control: Always Better Analysis (ABC), Vital Essential Desirable (VED), High Medium Low (HML), S for Scarce, D for Difficult and E for Easy to obtain (SDE), Seasonal items and off season items (S-OS), Fast moving, Slow moving and Non moving items (FSN) and X for high valued, Y for moderate value and Z for low valued items (XYZ) analysis
Examples and problems

5. Sequencing Models and Related Problems

[10]

Sequencing problems, Assumption in sequencing problems, processing n jobs through one machine, processing n jobs through two machines, processing n jobs through three machines, processing two jobs through m machines, processing n jobs through m machines.
Examples and problems

References:

1. Berger J.O. (1993). *Statistical Decision Theory and Bayesian Analysis*, Springer Series
2. Wald A. *Statistical Decision Functions*, John Wiley and Sons, New York, Latest Edition
3. Koch Karl-Rudolf (2007). *Introduction to Bayesian Statistics*, 2nd edition, Springer Publication.
4. Taylor Bernard W., (2007). *Introduction to Management Science*, Prentice Hall, Pearson Education
5. Vohra N.D.(2006). *Quantitative Techniques in Management*, TATA McGraw Hill
6. Sthapit Azaya, Rashindra P. Yadav, Govinda Tamang (2015). *Operations Research* Asmita Publication, Kathmandu.
7. Gupta Prem Kumar, Hira D. S (2007). *Operations Research*, 4th edition, S. Chand & Company Ltd.
8. J. K. Sharma (2001). *Operations Research Theory and Application*, Macmillan India
9. Goel B. S. , Mittal S. K. (1991). *Operation Research*, Reprint, Pragati Prakashan India.