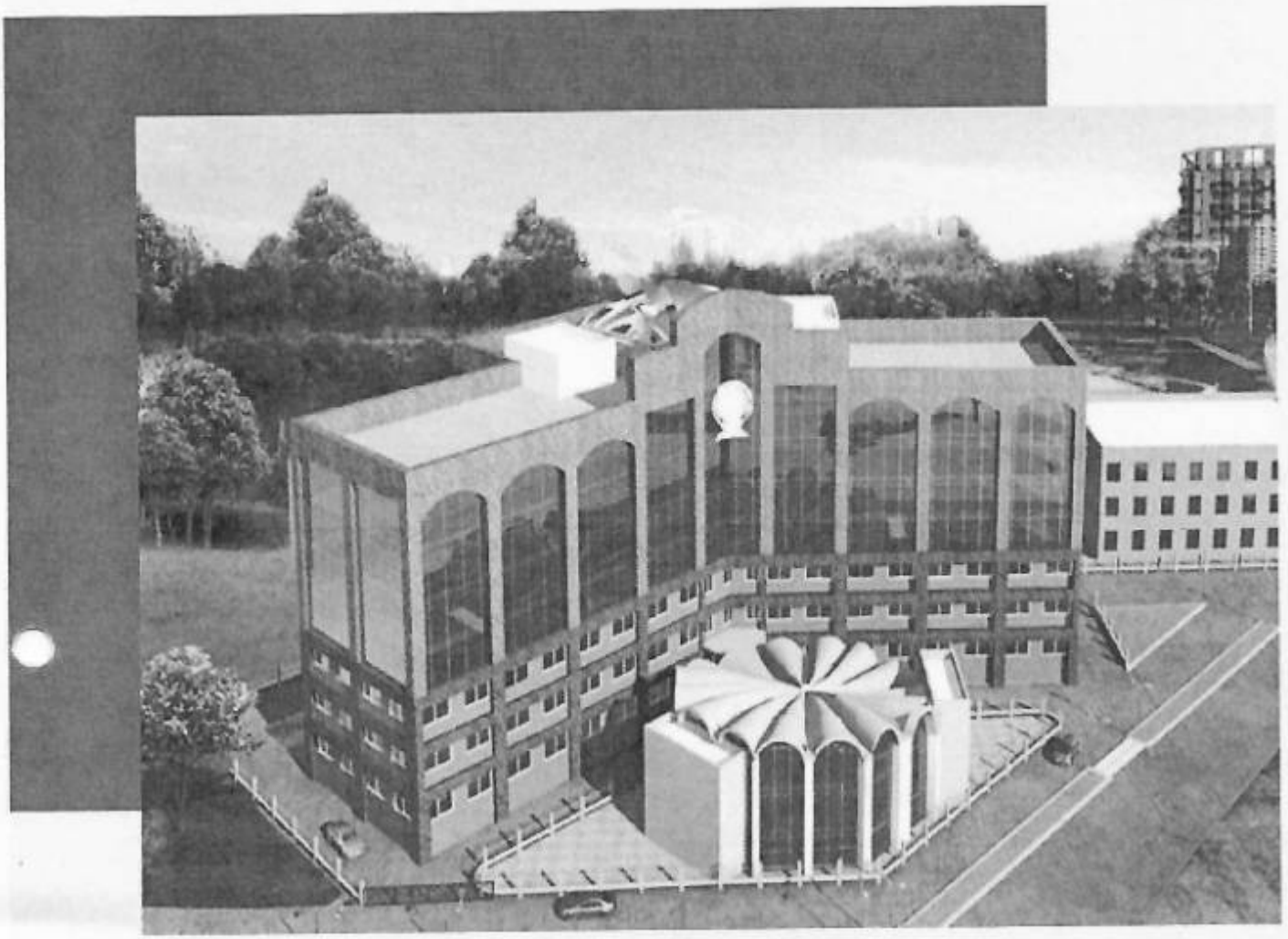

Master of Science in Survey Research and Data Analytics

Syllabus

Approved by the Academic Council on 08 May 2025

(स्थापना: Established in 1956)
बेहतर भविष्य के लिए क्षमता निर्माण
Capacity Building for a Better Future

INTERNATIONAL INSTITUTE FOR POPULATION SCIENCES

(Deemed to be University)

Deonar, Mumbai 400 088 **http://iipsindia.ac.in**

Programme Outcomes:

- To create Survey Research Experts, Data Analysts, for the future, equipped with necessary skills and expertiseto address evolving population and health concerns.
- To widen the relevance of the discipline of Survey Research and Data Analytics in the discipline of Population Health and Social Sciences.
- Training students to encourage evidence-based policy making with an understanding of dynamics of data, healthcare informatics and program evaluation methods.
- To inculcate an interdisciplinary approach in their professional pursuit academic engagement.
- Prepare students for an advanced career in research and academics with sufficient adaptive potential to contribute in the national and international sphere.

Index to the Courses

Course Code	Course Name	Course type	Credits	Hours	L	T	P
SEMESTER-I							
IKS 401	Indian Knowledge System-1	IKS	2	30	2	0	0
MSD F401	Demographic Methods	F	3	45	2	1	0
MSD F402	Social Sciences Concepts	F	3	45	2	1	0
MSD C401	Mathematics for Data Analytics	C	2	30	2	0	0
MSD C402	Statistical Methods and Approaches	C	3	45	2	1	0
MSD C403	Acquainting with data: Surveys and Sources	C	2	30	2	0	0
MSD C404	Sample Survey Designs	C	2	30	2	0	0
MSD C405	Programming with R	C	2	45	1	0	1
MSD C406	Analytics in STATA	C	2	45	1	0	1
Semester Credits			**21**	**345**			
SEMESTER-II							
MSD C407	Data Visualization with Software	C	2	45	1	0	1
MSD C501	Principles and Methods of Data Collection	C	3	45	2	1	0
MSD C502	Advanced Sample Survey Designs	C	2	30	1	1	0
MSD C503	Data Quality Assessment and Management	C	3	45	2	1	0
MSD C504	Programming for Data Analytics in Python	C	2	45	1	0	1
MSD C505	Predictive Analytics: Theory and Practice	C	2	30	2	0	0
MSD E501	Introduction to Longitudinal Data Analysis	E	3	45	2	1	0
MSD E502	Spatial Analytics						
MSD E511	Health Systems, and Policies	E	3	45	2	1	0
MSD E512	Urbanization, Space and Planning						
MSD V1	Viva-voce	V1	2				
VAC 401	Value added course	VAC	NC	30			
MSD I	Internship on Survey Research and Data Analytics	I	NC				
Semester Credits			**22**	**360**			
Year 1 Credits			**43**	**705**			
SEMESTER-III							
IKS 501	Indian Knowledge System-2	IKS	2	30	2	0	0

MSD C506	Ethics in Research and Publications	C	2	30	2	0	0
MSD C507	Artificial Intelligence and Machine Learning Applications	C	3	45	2	1	0
MSD C508	Applied Multivariate Analysis	C	2	30	2	0	0
MSD C509	Program Monitoring and Evaluation Design	C	3	45	2	1	0
MSD C510	Analysis of Complex Survey and Estimation	C	2	30	1	1	0
MSD C511	Projections and Forecasting	C	3	45	2	1	0
MSD E521	Bayesian and Small area estimation Methods	E	3	45	2	1	0
MSD E522	Concepts and Measures of Global Health						
MSD E523	Demographic Models and Indirect Estimations						
MSD E524	Health Economics and Financing						
MSD E525	Population, Environment and Sustainable Development						
Semester Credits			**20**	**300**			
SEMESTER-IV							
MSD R501	Research Field work	R	6	90			
MSD R511	Review paper	R	3	45			
MSD R521	Project on Data Analytics	R	3	45			
MSD R531	Dissertation	R	8	120			
MSD V2	Viva-voce	V2	2				
Semester Credits			**22**	**300**			
Year 2 Credits			**42**	**600**			
TOTAL CREDITS (including 4 credits of viva-voce)			**85**	**1305**			

Notes:

- IKS-Indian Knowledge System course, F-Foundation course, C- Core course, E-Elective course, R- Research, VAC-Value Added Course, V-Viva voce, D- Dissertation, L-Lecture, T-Tutorial and P-Practical.
- NC: Non-Credited courses are not counted for calculating the final grade.
- Core course: Must for all the students and cannot be changed.
- Elective course: One elective course should be opted from a pair.
- Semester II: One elective should be opted from each group i.e. E501/502; E511/E512
- Semester III: One elective should be opted from each group; i.e. E521/E522/E523/E524/E525

SEMESTER – I

Course Code: IKS 401

Course Title: INDIAN KNOWLEDGE SYSTEM-1

Credit: 02
(Lecture: 2)

Hours: 30

COURSE OUTCOMES:

- To focus on the scientific and eternal Indian Knowledge System
- To know the diverse path of spirituality in India and its application in the management of modern life
- To know the contributions of the Indian Knowledge System to the world
- To understand population-related topics within the framework of the Indian Knowledge System

COURSE CONTENT:

Link from SWAYAM to be shared with the students by the coordinator.

Course Code: MSD F401

Course Title: DEMOGRAPHIC METHODS

Credit: 3 **Hours: 45**
(Lecture: 2, Tutorial: 1)

To introduce basic concepts, measures and pattern related to demography

COURSE OUTCOMES:

- To understand basic concepts and components of demography
- Basic knowledge of concepts, measures and determinants of fertility
- Working knowledge of mortality measures and life table construction
- To understand concept, measures and determinants of migration

COURSE CONTENT:

Introduction to Demography

Definition and Scope: Evolution of demography as a scientific discipline; Nature and scope of demography and changes in it over time. Multi-disciplinary nature of Demography, its linkage with other social science disciplines. Basic demographic concepts. Components of population change. Demographic transition (description rather than theory).

Measures of age and sex structure

Defining age and sex, sex ratio, sex ratio at birth, Classification of age group and their importance, Measures of age structure: Percent distribution, Median age, age-sex pyramid, dependency ratio and potential support ratio.

Factors affecting age and sex structure, Importance of age-sex structure in Demography. Socioeconomic implications of age and sex structure

Fertility

Importance of the fertility study in population dynamics; Basic terms and concepts used in the study of fertility.

Basic concepts; Problems in fertility analysis; period and cohort approaches; Period measures of fertility - basic fertility measures, order-specific fertility rates, Coale's fertility indices; Cohort measures; Birth interval analysis; Reproduction measures.

Determinants of natural fertility; Davis intermediate variables framework of fertility; Socioeconomic determinants of proximate variables; Lee and Bulatao framework of fertility determinants; Bongaarts proximate determinants.

Mortality

Need and Importance of the study of Mortality; Some basic measures: - crude death rate (CDR) and Age-Specific Death Rates (ASDRs) - their relative merits and demerits

Need and importance of standardization: direct and indirect technique of standardization of rates and ratios in the light of mortality rates; Decomposition

Infant mortality rate and its sub-divisions; Maternal Mortality Rate, Ratios, Life time risk; Issues related to estimation of maternal mortality measures

Basic concept of a life table; Types and forms of life table; Anatomy of life table; uses of life table in demographic analysis; Construction of life tables; model life tables

Migration

Concept of mobility and migration, sources and quality of data, types of migration, census definition of migrants, limitations

Internal migration patterns and characteristics in developing countries with a special focus on India; Determinants of internal migration: Causes of migration at the place of origin and at the place of destination; Patterns of international migration: Historical and recent trends; causes and consequences of international migration

Direct estimation of lifetime and inter-censal migration rates from census data; Indirect measures of net internal migration: Vital Statistics Method, National Growth Rate Method and Census and Life Table Survival Ratio methods; Methods of estimating international migration; Migration surveys

READING LIST:

Bhende, A. (1996). *Principles of population studies* (7th ed.). Himalaya Publishing House.

Bhende, A. A., & Kanitkar, T. (2003). *Principles of population studies* (16th revised ed.). Himalaya Publishing House.

Coale, A. J., & Demney, P. (1983). *Regional model life tables and stable populations*. Academic Press.

Davis, K. (1968). *The population of India and Pakistan*. Russell and Russell.

Hinde, A. (1998). *Demographic methods*. Arnold.

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Pathak, K. B., & Ram, F. (1998). *Techniques of demographic analysis* (pp. 108-153). Himalaya Publishing House.

Rowland, D. T. (2006). *Demographic methods and concepts*. Oxford University Press.

Shryock, H. S., Siegel, J. S., & Associates. (1980). *The methods and materials of demography* (Vols. 1 & 2). U.S. Bureau of the Census.

United Nations. (1974). *Methods of measuring internal migration* (Manual VI). United Nations.

United Nations. (1979). *Trends and characteristics of international migration since 1950* (Demographic Studies No. 64). United Nations.

United Nations. (1982). *Model life tables for developing countries*. United Nations.

Weeks, J. R. (2005). *Population: An introduction to concepts and issues* (9th ed.). Wadsworth Publishing Company.

Yaukey, D. (1985). *Demography: The study of human population*. St. Martins.

Course Code: MSD F402

Course Title: SOCIAL SCIENCES CONCEPTS

Credit: 3 **Hour: 45**
(Lecture: 2, Tutorial: 1)

To build foundation on social sciences including Sociology, Psychology, Geography, and Economics

COURSE OUTCOMES:

- To understand concepts of sociology, society, culture and social change.
- Acquire basic understanding of Social Psychological Concepts including Psychoanalysis, Personality Motivation, Attitude, Behaviour, Learning and Communication Processes

COURSE CONTENT:

Sociology

Sociology: sociology as a social science- its nature, subject matter and scope Relation of sociology with other social sciences, sociological perspective. Basic Concepts in sociology

The Family: Sociological Significance of the Family; Types and functions of Family; Nuclear and joint families

Marriage: Different forms of marriage, changing patterns of marriage/mate selection in India

Kinship –features of kinship system in India, regional variations

Social stratification: Social Class and Caste: Principles of Class and Caste

Socialization: agencies of socialization

Culture: meaning and characteristics of culture.

Society and Culture in India: Aspects of society and culture in India, and its role and importance in Population Studies.

Social Institutions and their role in influencing demographic situation of the Population of India - Family, Marriage, Kinship and Religion

Caste System: Concept and definition of Caste System, Changing Caste System in India

Social Mobility: vertical and horizontal, intra- and inter-generational mobility

Social Change: Definition and Concept of Social Change. Process of Social and Cultural Changes

in India and their role in influencing demographic behaviour:

a) Sanskritization
b) Westernization
c) Modernization

Social Psychological Concepts: Psychology as a Discipline: Branches and dominant psychological thoughts; Psychoanalysis: Cognitive Behaviour, Social Psychological Concepts and its relevance to Population Studies; Personality Motivation, Attitude, Behaviour, Learning and Communication Processes: Concept, Meaning, Scope, and need in the Context of Population Studies.

Geography

Importance of Geographical factors: Physical factors (relief, rainfall, temperature, soil and vegetation) Economic and Social factors (Mineral resources and industrialisation, transport, language, religion and caste/tribe); the influence of geographical factors on population.

Geographical approaches: the concept of region- formal and functional regions; the concept of growth pole and regional development; core and periphery; distance and decay function; Maps-scale, choropleth, isopleths and distribution maps.

Physical divisions of India; administrative organization of India. Historic-Cultural regions; Agro-climatic regions; NSS regions.

Theoretical Perspectives in Geography: Place of geography in social sciences; man, and nature relationship- determinism and possibilism; Positivism (quantification) and Phenomenology; and Radical and Postmodern Geography.

Concept of Social Space; Social Structure and Spatial Structure; Role of time and space in social sciences.

Economics

Introduction: Defining Economics, Micro and Macroeconomics, Economic and non-economic good, Basic Economic Activities, Factors of Production, Economic Systems.

Basic Concepts in Micro Economics: Concept of Marginal and Total Utility, Law of Diminishing Marginal Utility, Theory of Demand: Indifference curves Theory and Properties, Equilibrium of consumer, Income, Substitution and Price effect. Elasticity of Demand: Price, Income and cross elasticity, Basic concepts in theory of production, cost and market structure.

Basic Concepts in Macro Economics: Basic Concepts in National Income: Concept of GDP, NDP,

GNP, NNP, NI, PCI, GDPPCI, PPP, GDPPCI (PPPUS$), Theory of consumption and saving: Consumption function, Keynes' Psychological law of consumption, concept of APC and MPC, APS and MPS, Factors affecting consumption and savings, Basic concept of Investment.

Economic Theories: Political economy and protectionism – Mercantilism, Classical economics and free enterprise – Adam Smith and David Ricardo, Welfare economics – Alfred Marshall and Amartya Sen, Karl Marx and the Labour theory of Value, Empirical economics – Paul Samuelson.

Indian Economy: Structure, Planning and Growth: Characteristics of Indian Economy: Economic Transition in India, Strategy of economic planning in India, Industrial Policy 1956, 1977 and 1991, New Economic Reforms- 1991, Other Development issues: Poverty and Unemployment.

READING LIST:

Abler, R., Adams, J., & Gould, P. (1971). *Spatial organization: The geographer's view of the world*. Prentice Hall.

Ahuja, H. L. (n.d.). *Advanced economic theory: Microeconomic analysis*. S. Chand and Company Limited.

Blaug, M. (1962). *Economic theory in retrospect*. Heinemann Ltd.

Burkeman, O. (2012). *The antidote: Happiness for people who can't stand positive thinking*. Faber & Faber.

Charles, M. D. (2012). *The power of habit*. Random House.

Dasgupta, A. K. (n.d.). *Epochs of economic theory*. Oxford University Press.

Datt, R., & Sundaram, K. P. M. (2000). *Indian economy*. S. Chand & Company Ltd.

Davis, K. (1975). *Human society*. MacMillan and Co.

Freud, S. (1900). *The interpretation of dreams*. Macmillan.

Francis, J. M. (1956). *Maps and diagrams: Their compilation and construction*. University of Michigan.

Friedman, J. F. (1966). *Regional development policy: A case study of Venezuela*. MIT Press.

Government of India, Ministry of Finance, Economic Division. (2001–2002). *Economic survey*.

Haney, L. H. (1960). *History of economic thought*. Macmillan.

Haralambos, M. (1980). *Sociology: Themes and perspectives*. Oxford University Press.

Horney, K. (1937). *The neurotic personality of our time*. W. W. Norton & Company.

Johnston, R. J. (2004). *Geography and geographers*. Oxford University Press.

Jung, C. G. (1964). *Man and his symbols*. Doubleday.

Kalat, J. W. (2013). *Introduction to psychology* (10th ed.). Cengage Learning.

Kapadia, K. M. (1966). *Marriage and family in India*. Oxford University Press.

Koutsoiannis, A. (1979). *Modern microeconomics*. Macmillan Press Ltd.

Kuppuswamy, B. (1972). *Social change in India*. Konark Publication Pvt. Ltd.

Lipsey, R., & Chrystal, A. (2004). *Economics*. Oxford University Press.

MacIver, R. M., & Page, C. H. (1949). *Society: An introductory analysis*. Holt, Rinehart and Winston.

Magill, F. N. (Ed.). (1995). *International encyclopedia of sociology*. Fitzroy Dearborn Publishers.

Mandelbaum, D. G. (1970). *Society in India: Continuity and change (Vol. 1) and Change and continuity (Vol. 2)*. University of California Press.

McGee, R. (1980). *Sociology: An introduction*. Holt, Rinehart and Winston.

Muzumdar, H. (1966). *The grammar of sociology: Man in society*. Asia Publishing House.

Peet, R. (1998). *Modern geographic thought*. Blackwell Publishers.

Samuelson, P. A., & Nordhaus, W. D. (n.d.). *Economics*. Tata McGraw Hill.

Singh, R. L. (1971). *India: A regional geography*. National Geographical Society of India.

Srinivas, M. N. (1966). *Social change in modern India*. University of California Press.

United Nations. (n.d.). *Trends and characteristics of international migration since 1950* (Demographic Studies No. 64). United Nations.

Course Code: MSD C401

Course Title: MATHEMATICS FOR DATA ANALYTICS

Credit: 2
(Lecture: 2)

Hour: 30

To comprehend students with knowledge of basic mathematics and computational techniques which are essential to build foundation for survey research methods and data analytics.

COURSE OUTCOMES:

- To understand basic concepts of metrics linear algebra which will be useful in data analytics
- To acquire knowledge of numerical methods which is essential basic knowledge for understanding dynamics of data.
- To understand basic concepts of functions, equations and their solutions

COURSE CONTENT:

Set Theory and Vector

Sets, Types of Sets, Basic Operations on Sets, Venn diagram, Cartesian product of two sets, Distributive law, De Morgan's Law, Definition of functions, Domain and Range, Increasing and decreasing functions, Concavity of functions, Types of vectors, Vectors in 2d and 3d planes, vectors in Rn, Vector addition, scalar multiplication and their properties, Dot product, cross product and their applications, Orthogonality

Matrices

Matrix, Submatrix, types of matrices, symmetric, square, diagonal matrices, singular and non-singular matrices. Addition, Subtraction, multiplication of matrices, Rank of matrix. Trace, Determinants Transpose, Inverse, eigenvalues, eigenvectors

Vector space

Definition of vectors spaces over real numbers, Subspaces of a vector space, Linear span of vectors, linear dependence and linear independence, Basis and dimension of vector spaces, linear

transformation, the matrix of Linear Transformation, Rank Nullity theorem, change of basis and similar matrices

Numerical Methods

Factorial, finite differences, and interpolation. Operators, E and divided difference. Newton's forward, backward and divided differences interpolation formulae. Lagrange's interpolation formulae. Central differences, Gauss and Stirling interpolation formulae. Constant change and linear growth, Equation of lines, Linear functions and graphs, Quadratic, Exponential, and Logarithmic Functions, derivatives. Solutions to differential equations

Basic concepts for computations

Events, variable, measurement scale of variable, Person-time, Proportion, Ratio, Rate, and Probability, Period, cohort measures, incidence, prevalence.

READING LIST:

Gentle, J. E. (2007). *Matrix algebra: Theory, computations, and applications in statistics*. Springer Science+Business Media.

Goel, B. S., & Mittal, S. K. (2008). *Numerical analysis*. Pragati Prakashan.

Jain, M. K., Iyengar, S. R. K., & Jain, R. K. (2003). *Numerical methods for scientific and engineering computation*. New Age International Publishers.

Kolman, B., Busby, R. C., & Ross, S. (n.d.). *Discrete mathematical structures*. PHI Learning.

Malik, S. C., & Arora, S. (1994). *Mathematical analysis* (2nd ed.). Wiley Eastern Limited, New Age International.

Course Code: MSD C402

Course Title: STATISTICAL METHODS AND APPROACHES

Credit: 3 **Hour: 45**
(Lecture: 2, Tutorial: 1)

To provide students with basic knowledge of statistical techniques which is essential to build foundation for survey research methods and data analytics.

COURSE OUTCOMES:

- Learn basic measures of central tendency and dispersion.
- Working knowledge of probability distribution.
- Knowledge of concept of correlation and regression and interpretations of coefficients.
- Know basic concept of inferential statistics, including choosing appropriate statistic to test hypothesis.

COURSE CONTENT:

Introduction to statistics

Descriptive and Inductive statistics. Concept of variables, Nominal, Ordinal and Interval and ratio scale variables. Presentation of data, conversion of raw data into frequency distribution, graphical presentation of nominal, ordinal data.

Measures of Central Tendency/Position

Mean (arithmetic, geometric, harmonic) Median, Mode; Merits and demerits of different measures, Quartiles, Deciles, Percentiles.

Measures of dispersion

Range, Variance, Standard Deviation; Merits and demerits of different measures of dispersion, Skewness and Kurtosis.

Introduction to probability

Definition of probability, Events: exhaustive, mutually exclusive, equally likely events; Laws of probability, additive and multiplicative laws of probability, Bayes' theorem with application.

Discrete probability distribution

Binomial and exponential functions, Binomial probability distribution and Poisson distribution and their properties.

Continuous probability distribution

Introduction to Normal distribution and its properties, applications of normal distribution.

Correlation & Regression

Definition of correlation, scatter diagram, Pearson correlation coefficient, and its properties; Spearman ranks correlation coefficient. Concept of linear regression, fitting of regression line. Linear, logistic regression models, standardized regression coefficients.

Statistical Inferences

A. Estimation:

1. Population, random sample, parameter, statistic, estimator, sampling distribution of random sample, joint and marginal distribution of functions of random variables.
2. Statistical inference for Normal distribution, Chi-Square distribution, F-distribution, Student's t-distribution, Law of large numbers, Central Limit Theorem
3. Confidence interval: Point estimation and interval estimation, Confidence interval for mean, difference in means and proportion, Methods of finding confidence interval.
4. Maximum likelihood estimation (MLE), Likelihood ration test, Goodness-of-fit test, mean square error, unbiasedness, sufficiency, efficacy of estimates, minimum variance unbiased estimator (MVUE), Cramer-rao lower bound of variance

B. Testing of Hypothesis:

1. Statistical hypotheses- simple and composite, statistical tests, critical region, Type I and Type II errors, size and power of test.

2. Definition of most powerful (MP), and uniformly most powerful (UMP) tests, power functions of tests with illustration, Neyman-Pearson lemma and its application in hypotheses testing for Binomial, Poisson, Normal and Exponential distributions.
3. One sample and two sample tests for mean, test for a binomial proportion; Score test versus Wald; Exact binomial test; Tests for differences in binomial proportions; Intervals for differences in binomial proportions.
4. Tests of significance: Independent sample t-test, Paired t-test, Chi-square test for association, ANOVA.
5. Fisher's exact test; Hypothesis tests of marginal homogeneity; Estimating marginal risk difference; Estimating marginal odds ratios; Distinction between conditional and marginal odds ratios.
6. Non-parametric hypothesis testing: sign test, Wilcoxon-Mann-Whitney test, run test, median test, and test (based on Spearman's rank correlation).

C. Advance topics in interference:

Bootstrap methods for inference, permutation tests, model selection and regularization.

READING LIST:

Bhat, N. R., & Singh, M. R. (1993). *Applied mathematics*. Tata McGraw-Hill Publishing Company Ltd.

Blalock, H. M. (1960). *Social statistics*. McGraw-Hill Book Company.

Chakravorti, S. R., & Giri, N. (1997). *Basic statistics*. South Asian Publishers.

Clarke, G. M., & Cooke, D. (1994). *A basic course in statistics*. Arnold.

Dillon, W. R., & Goldstein, M. (1984). *Multivariate analysis*. John Wiley & Sons.

Dixon, W. J., & Massey, F. J. (1983). *Introduction to statistical analysis* (4th ed.). McGraw-Hill.

Douglas, & Altman. (2006). *Practical statistics for medical research*. Chapman and Hall.

Ebdon, E. (1978). *Statistics in geography*. Basil Blackwell.

Fisher, L. D., & Van Belle, G. (1993). *Biostatistics: A methodology of the health sciences*. Wiley-Interscience.

Goon, A. M., Gupta, M. K., & Dasgupta, B. (1985). *Fundamentals of statistics* (Vol. I). The World Press Private Ltd.

Graeme, H., & Sofroniou, N. (1999). *The multivariate for social scientists*. SAGE Publications.

Gupta, S. C., & Kapoor, V. K. (1986). *Fundamentals of mathematical statistics*. Sultan Chand & Sons.

Hogg, R. V., & Craig, A. T. (n.d.). *Introduction to mathematical statistics* (4th ed.). Collier Macmillan.

Howell, D. C. (n.d.). *Fundamental statistics for the behavioral sciences* (4th ed.). International Thomson Publishing.

Jain, S. K. (1979). *Basic mathematics for demographers*. Australian National University.

Jack, L. (n.d.). *Inference principles for biostatisticians*.

Kolman, B., Busby, R. C., & Ross, S. (n.d.). *Discrete mathematical structures*. PHI Learning.

Kurtz, N. R. (1999). *Statistical analysis for the social sciences*. Allyn & Bacon.

Larry, W. (n.d.). *All of statistics: A concise course in statistical inference*.

Lipshutz, S. (n.d.). *Schaum's outline of set theory and related topics*. McGraw-Hill.

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McClave, J. T., Benson, P. G., & Sincich, T. (2001). *Statistics for business and economics* (8th ed.). Prentice Hall.

Mood, A. M., Graybill, F. A., & Boes, D. C. (n.d.). *Introduction to the theory of statistics* (3rd ed.). McGraw-Hill.

Norman, R. K. (1999). *Statistical analysis for the social sciences*. Allyn & Bacon.

Prakasam, C. P., Rama Rao, G., & Upadhyay, R. B. (1987). *Basic mathematics in population studies*. Gemini Publishers.

Retherford, R. D., & Choe, M. K. (1993). *Statistical models for causal analysis*. Wiley-Interscience.

Rao, C. R. (n.d.). *Linear statistical inference and applications* (Revised ed.). Wiley Eastern.

Siegel, J. J., & Swanson, D. A. (Eds.). (2004). *The methods and materials of demography* (2nd ed.). Elsevier Academic Press.

Sundaram, K. R., Dwivedi, S. N., & Sreenivas, V. (2009). *Medical statistics: Principles & methods*. Anshan Publisher.

Venkatachary, K. (1994). *Elements of mathematics for demographers* (Monograph Series No. 9). Regional Institute for Population Studies, University of Ghana.

Course Code: MSD C403

Course Title: ACQUAINTING WITH DATA: SURVEYS AND SOURCES

Credit: 2 **Hour: 30**
(Lecture: 2)

To introduce different data sources and provide an overview of Demographic and Population health surveys across the globe and India.

COURSE OUTCOMES:

- Working knowledge of the Census, registration system, and history of demographic data sources.
- To comprehend the need, objectives and importance of large-scale data in monitoring and evaluation of health and population policies and programmes.
- Introduced global and national importance surveys.
- Understand the stages of completing a useful and appropriate survey.

COURSE CONTENT:

History of Demographic and Health Data Sources

Paris registers, Population registers, Census, Vital registration data, Bills of mortality, Fiscal documents, Military records, Inventories of properties, Genealogies, Marriage practices, Archaeological remains, administrative geography, Colonization of new land, Cemetery data, Traveler's tales.

Population Census and Registration System

Population Census: Population census across the world. Census taking under British India, Indian census, details of different items on which Indian census collect data, enumeration method, publications of census data/ reports.

Registration system: Vital registration system, Civil registration system, Sample registration system (SRS), survey on causes of death, HMIS.

Scope of large-scale survey and its phases

Need for large scale surveys, objectives of cross-sectional, longitudinal, rotational and intepenetrating surveys, representativeness. Planning, sampling design, developing data collection tools, field implementation, data process, analysis, report writing and dissemination

Introduction to Demographic, Population Health surveys

Global surveys: World Fertility Survey (WFS); Demographic Health Survey (DHS); Multiple Indicator Cluster Survey (MICS); World Health Survey (WHS); Health and retirement Survey (HRS); Study om Global Ageing and Adult Health Survey (SAGE).

Nationwide large-scale surveys: National Sample Survey Organization's surveys, details of different rounds collecting population and health data; National Family Health Survey (NFHS); District Level Household and Facility Survey (DLHS); Annual Health Survey (AHS); Longitudinal Ageing study in India Survey; Study on Global Aging and Adult Health Survey (WHO-SGAE)-India; Global Youth Tobacco Survey (GYTS); Global Adult Tobacco Survey; Nutritional Specific Surveys.

READING LIST:

Bhende, A. (1996). *Principles of population studies* (7th ed.). Himalaya Publishing House.

Davis, K. (1968). *The population of India and Pakistan*. Russell and Russell.

Family Health International. (2000). *Behavioral surveillance surveys*. Family Health International.

Livi-Bacci, M. (1996). *A concise history of world population* (2nd ed.). Oxford University Press.

Maheshwari, S. R. (1996). *The census administration under the Raj and after*. Concept Publishing Company Pvt. Ltd.

Registrar General of India. (2011). *Census of India - 2011*. Ministry of Home Affairs, Government of India.

Siegel, J. S., & Swanson, D. A. (2004). *The methods and materials of demography* (2nd ed.). Elsevier Science.

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United Nations. (2005). *Household sample surveys in developing and transition countries*. United Nations.

Weeks, J. (2005). *Population: An introduction to concepts and issues* (9th ed.). Wordsworth Learning.

World Population Prospects. (n.d.). *World population prospects*. United Nations.

Online Source: United Nations Statistics Division. (n.d.). *Household sample surveys*. https://unstats.un.org/unsd/hhsurveys/

Course Code: MSD C404

Course Title: SAMPLE SURVEY DESIGNS

Credit: 2 **Hour: 30**
(Lecture: 2)

COURSE OUTCOMES:

- Gain understanding of basic concepts related to sample surveys with specific references to health and demographic surveys.
- Gain understanding of basic sample survey designs.
- Learn skills to design and implement sample surveys in keeping with research objectives.

COURSE CONTENT:

Concept of sampling:

Concept of population and sample, need for sampling, sample survey verses census, elementary units, sampling units, assumptions of sampling from finite population, sampling frame, selection and inclusion probabilities, concept of sampling mechanism and sampling design. Types of sampling methods, Probability sampling designs, Nonprobability sampling designs.

Sample size computation

Sample size calculations using estimation targets based on relative standard error, margin of error, and power requirements.

Simple Random Sampling with and without replacement

Estimation of population means and totals; Sampling error and variance estimation.

Stratified Sampling

Description; estimation of mean, total, and proportions; sampling variance of mean, total, and proportions; allocation and selection of units; advantages of stratification.

Systematic random sampling:

Concept of systematic sampling, comparison with simple random sampling, variance estimation, comparison with stratified random sampling, systematic sampling, selection procedure for fractional interval, circular systematic sampling; advantages and disadvantages of systematic sampling.

Cluster Sampling

Description; method of selection; estimation of parameters; estimation of sampling variance of parameters.

READING LIST:

Cambridge University Press, New Delhi.

Cochran, W. G. (1977). *Sampling technique* (3rd ed.). John Wiley & Sons.

Damico, A. (n.d.). *Step-by-step instructions to analyze major public-use survey data sets with the R language*.

Des Raj. (1972). *The design of sample surveys*. McGraw-Hill.

Fares Qeadan. (n.d.). *Sampling methods using STATA*.

Kish, L. (1995). *Survey sampling*. John Wiley & Sons.

Ladusingh, L. (2018). *Survey sampling methods*. PHI Learning.

Lohr, L. S. (1999). *Sampling: Design and analysis*. Duxbury Press.

Lumley, T. (n.d.). *Complex surveys: A guide to analysis using R*.

Murthy, M. N. (1977). *Sampling theory and methods* (2nd ed.). Statistical Publishing Society.

Roy, T. K., Acharya, R., & Roy, A. K. (2016). *Statistical survey design and evaluating impact*. Cambridge University Press.

Sukhatme, P. V., & Sukhatme, B. V. (1970). *Sampling theory of surveys with applications*. Asia Publishing.

Course Code: MSD C405

Course Title: PROGRAMMING WITH R

Credit: 2
(Lecture: 1, Practical: 1)

Hour: 45

COURSE OUTCOMES:

- Learn open-source software R for data analysis.
- Learn exploratory data analysis with R.
- Learn use of R programming for model development.

COURSE CONTENT:

Introduction

Introduction to R/RStudio; advantages of R over other programming languages; R packages for data science

Importing and introduction to dataset

Understanding the data; importing and exporting data; getting started analyzing data; accessing database; calculations, numbers, vectors, objects, arrays and metrices, data frame

Data Visualization

Histogram; boxplots; bar charts; line graphs; heat map; scatterplots; pie charts; customize plot axes, labels, add legends, and add colors

Data manipulation

Pre-processing data; handling missing values; data formatting; data normalizing; grouping data values into bins; converting categorical variables into numerical quantitative variables

Exploratory data analysis

Computation of measures of central tendency and dispersion; computation of correlation coefficient; chi-square test for association between two categorical variables

Model development

Linear regression, multiple linear regression, binary logistic regression; ordinal logistic regression.

READING LIST:

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *Introduction to statistical learning with applications in R.* Springer. Available online: https://www.springer.com/gp/book/9781461471370

Kleiber, C., & Zeileis, A. (2008). *Applied econometrics with R.* Springer-Verlag.

The R Foundation. (n.d.). *The R project for statistical computing*. Retrieved from https://cran.r-project.org/

RStudio. (n.d.). *Download RStudio*. Retrieved from https://www.rstudio.com/

Video Tutorials. (n.d.). *Installing R on Mac.*

Video Tutorials. (n.d.). *Installing R on Windows.*

Course Code: MSD C406

Course Title: ANALYTICS IN STATA

Credit: 2 **Hour: 45**
(Lecture: 1, Practical: 1)

COURSE OUTCOMES:

- Familiarity with STATA for data analysis.
- Learn model development in STATA.
- Learn use of STATA for survey data analysis.

COURSE CONTENT:

Introduction to STATA
Facilities, creating database structure, data entry, specifying scales, validation of data entry, importing and exporting data.

Importing dataset
Understanding the data; importing and exporting data; getting started analyzing data; accessing database.

Data visualization
Histogram; boxplots; bar charts; line graphs; heat map; scatterplots; pie charts; customize plot axes, labels, add legends, and add colors.

Data manipulation
Recoding; creating new variable; sorting; filtering and selection of specific data; merging files; generating simple frequencies; use of syntax editor; handling missing values.

Exploratory data analysis
Computation of measures of central tendency and dispersion; computation of correlation coefficient; chi-square test for association between two categorical variables.

Model development
Linear regression analysis - interpretation and regression diagnostic test; regression models for binary outcomes, categorical, and ordinal outcomes.

Survey data analysis
Introduction; need for using survey data commands; estimation of means, proportions, ratios, totals; regression models for binary outcomes, categorical, and ordinal outcomes.

READING LIST:

StataCorp. (2021). *STATA survey data reference manual* (Release 17). StataCorp LLC.

StataCorp. (2021). *STATA user's guide* (Release 17). StataCorp LLC.

SEMESTER II

Course Code: MSD C407

Course Title: DATA VISUALIZATION WITH SOFTWARE

Credit: 2
(Lecture: 1, Practical: 1)

Hour: 45

To introduce Microsoft power BI and R for data visualization and interactive dashboards.

COURSE OUTCOMES:

- Develop data visualization and infographics thinking
- Create interactive dashboards using Microsoft Power BI
- Prepare attractive and meaningful graphs, maps using different software

COURSE CONTENT:

Data-Analytic Thinking and infographics

Knowing your data, Different types of data, Data pre-processing, Storytelling with data, infographics, making dashboards, Understanding the concepts of dynamic/interactive data visualization and report generation.

Data Visualization from Different Sources

Understanding structured, unstructured and semi-structured data sources, Data modelling and creating visualization, Data modelling and creating visualization, charts/dashboards from semi-structured data like CSV files, XML, JSON and others, Data modelling and creating, visualization charts/dashboards from live streaming data.

Data visualization with Power BI

Introduction to Power BI, data import, cleaning, building data models, creating visualization, types of visualization, Identify the differences between filters and slicers in a Microsoft Power BI, Customize the filter pane for reporting needs, Making interactive dashboards.

Data Visualization With R

Introduction to R programming, R studio projects, Visualization using R, Transformation using R, Exploratory data analysis, Data manipulation with dplyr (introduction to dplyr package), Data visualization with plot, ggplot2, Data presentation with R Markdown.

READING LIST:

Zhou A. (2022). Data Visualisation in R, Quantitative Methods in Global Health. URL https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2488/2022/09/Data-Visualization-in-R.pdf

Long, J. D., & Teetor, P. (2019). R cookbook: proven recipes for data analysis, statistics, and graphics, CA: O'Reilly. URL: https://rc2e.com/

Core Python Programming - Second Edition, R. Nageswara Rao, Dreamtech Press

R Graphics Essentials for Great Data Visualization by Alboukadel Kassambara

Wickham, H. and Grolemund, G. (2016): R for Data Science Import, Tidy, Transform, Visualize, and Model Data. O'Reilly.

Lander, J.P. (2017): R for Everyone-Advanced Analytics and Graphics. Pearson Education

Gandrud, C. (2020): Reproducible Research with R and R Studio. 3rd edition, CRC Pres

Course Code: MSD C501

Course Title: PRINCIPLES AND METHODS OF DATA COLLECTION

Credit: 3 **Hour: 45**
(Lecture: 2, Tutorial: 1)

To comprehend with working knowledge of data collection methods, questionnaires and software

COURSE OUTCOMES:

- To understand the research design and scientific approaches to conduct of research in varied settings.
- Understand different interview techniques and methods of data collections
- Able to design checklist and guidelines for qualitative data collection
- Understand questionnaire structure and standards for large scale quantitative surveys

COURSE CONTENT:

Need for Research and its phases

Definition of Research, Assumptions, Operations and Motivations and Aims of Scientific Research. The Research Process: conceptual, Empirical and Analytical Phases of Research.

Research Designs

Conceptual vs. Empirical; Quantitative vs. Qualitative, Observational Studies: Descriptive, Analytical studies, explanatory, and exploratory, Experimental Studies: Pre-test design, post-test design, Follow-up, longitudinal design, Action research studies, Panel Studies; evaluative studies.

Research Process

Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review, identifying gap areas from literature and research database, development of working hypothesis, conceptual framework, sampling, developing tools, data collection, process, analysis, report writing.

Data collection and Interview Techniques

Mail method, interviews through telephone, internet and computers, face-to-face interviews or personal, self-administered and interview administered questionnaire, Quantitative vs. qualitative data collection, Principles and guideline for interview, language.

Qualitative Methods of data collection

In-depth interviews, key informant interview, observation (participatory and non-participatory), focus group discussion, content analysis, social mapping, social networking, free listing, pile sorting, projective techniques, mechanical devices (camera, tape recorder), mystery client technique, vignettes method.

Questionnaire Development for quantitative surveys: Types of Questionnaire/schedule, Checklist schedules, structure of questionnaire, roster, skipping non applicable questions, checks. Standardization of tools, Principles of constructing a questionnaire/ interview schedule, Types of questions (knowledge, attitudinal, behavioral, practice), framing of questions (simple, delicate, personal matter), sequencing of questions. Updating/developing new questions. Testing survey tools: Pretest. Translation in regional language

Attitude Scales: Point scales, ranking scales, rating scales, limitations of attitude scales, Types of Scales: Bogardus, Guttman, Likert, Semantic, Thurstone scale.

READING LIST:

Bernard, H. R. (1995). *Research methods in anthropology: Qualitative and quantitative approaches*. Altamira Press.

Goode, W. J., & Hatt, P. K. (1952). *Methods in social research*. McGraw-Hill.

Mukherji, P. N. (1999). *Methodologies in social science*. Sage Publications.

Singleton, R. A., & Straits, B. C. (1999). *Approaches to social research*. Oxford University Press.

United Nations. (2005). *Household sample surveys in developing and transition countries*. United Nations Statistics Division. www.unstats.un.org/unsd/hhsurveys/

Young, P. V. (1994). *Scientific social surveys and research* (4th ed.). Prentice-Hall.

DHS Manuals.

NFHS Manual for interviewer.

LASI Manual for interviewer.

Course Code: MSD C502

Course Title: ADVANCED SAMPLE SURVEY DESIGNS

Credit: 2 **Hour: 30**
(Lecture: 1, Tutorial: 1)

COURSE OUTCOMES:

- Know and appreciate the sampling design of large-scale surveys conducted in India.
- Learn estimation of sampling errors in large-scale surveys.
- Become aware about the concept of sampling weights and estimation and application of sampling weights in large-scale surveys.

COURSE CONTENT:

Advanced concepts

Use of auxiliary information, ratio and regression methods of estimation under simple random sampling, bias, mean square error, and ratio and regression estimators in stratified random sampling.

Multi-stage designs

Introduction; two-stage design; selection of sampling units at different stages; estimation of mean and sampling variance; design effect; intra-class correlation; probability proportional to size sampling

Examples of sampling design of large-scale surveys

National Family Health Survey; Longitudinal Ageing Study in India; Sample registration System; National Sample Survey Organization Surveys

Sampling weight and estimation of sampling errors

Description; computation of sampling weight under different designs; self-weighting designs; post-stratification, Taylor series linearization method

Non-sampling errors

Introduction; coverage error; non-response error; response error

READING LIST:

Cochran, W. G. (1977). *Sampling technique* (3rd ed.). John Wiley & Sons.

Kish, L. (1995). *Survey sampling*. John Wiley & Sons, Inc.

Ladusingh, L. (2018). *Survey sampling methods*. Prentice Hall India.

Roy, T. K., Acharya, R., & Roy, A. K. (2016). *Statistical survey design and evaluating impact*. Cambridge University Press.

United Nations. (2005). *Household sample surveys in developing and transition countries*. United Nations.

Course Code: MSD C503

Course Title: DATA QUALITY ASSESSMENT AND MANAGEMENT

Credit: 3 **Hour: 45**
(Lecture: 2, Tutorial: 1)

Learn the assessment of quality of demographic and health data with special focus on age data, missing values, and outliers.

COURSE OUTCOMES:

- Demonstrate an understanding of the theoretical basis of survey measurement and measurement error; Identify appropriate survey design strategies for a range of measurement challenges
- Vision to judge the quality of data, comment on it and adjust the data.
- Learn data processing, including handling missing data and outliers.
- Familiarize to large-scale survey data handling software (STATA).

COURSE CONTENT:

Data Quality Assessment: Reliability and validity of measurement: Face, content, construct, convergent, concurrent, and predictive validity; Inter-coder reliability, stability, non-random and random errors, scaling and composite indices.

Appraisal of the quality of demographic and health data; Completeness of registration data Types of errors, coverage and content errors. Sources of errors.

Examples of data on survey, and census and registration data affected by errors; sampling and non-sampling errors; methods of detecting errors in population data;

Evaluation and measurement of errors in age reporting; methods of adjustment for age-sex data; method of graduation.

Post-enumeration surveys; dual record system.

Techniques of evaluation of age data using Whipple's index, Myer's index, UN Joint score

Quality assurance procedures in survey

Building Checks in data collection tools for consistency in responses, spot check, Revisit of sub-

samples, field check tables, Use of AI/ML in data quality assurance, digitization of survey process, non-response pattern, and quality lot assurance, roles of supervisors, editors, field and nodal agencies. Third party audit.

Large scale data processing and conversion: process from data collection, validation, cleaning, editing to recoding., conversion to different file format, Conversion of ASCII/ CSPro data into STATA or other formats.

- Handling Missing Data: Assessment of missing data: missing at random, logical, non-response pattern, bias, replacing missing data, imputations by average, by regression method
- Data Management in Software: Introduction to STATA -facilities, creating database structure, data entry, specifying scales, validation of data entry, importing and exporting data. Reshape data structure and merging files.
- Data manipulation using STATA – recoding creating new variable, sorting, filtering and selection of specific data, generating simple frequencies, use of syntax editor.
- Commands in SQL, data types in SQL, data manipulation and data processing with SQL

READING LIST:

Bhat P.N.M., (2002): Completeness of India's Sample Registration System: An assessment using the general growth balance method, Population Studies, 56 (2002), 119-134, Printed in Great Britain.

Seigel Jacob S. and David A. Swanson (eds.) (2004): The Methods and Materials of Demography. 2nd Edition, New York: Elsevier Academic Press. Chapters 20 & 21.

Stata user's guide: Release 10., 2nd Edition. Stata Press

Stata survey data reference manual: Release 8., 2nd Edition. Stata Press.

Course Code: MSD C504

Course Title: PROGRAMMING OF DATA ANALYTICS IN PYTHON

Credit: 2 **Hour: 45**
(Lecture: 1, Practical: 1)

To introduce the basic and advanced programming in Python.

COURSE OUTCOMES:

- Demonstrate the programming skills in Python
- Apply the Python programming for data visualization, and analysis

COURSE CONTENT:

Introduction

Introduction to Python; Advantages of python over other programming languages, various Python IDEs, Sequence data types and associated operations, List, Dictionaries, Regular Expressions, Conditions and loops, Python packages for data science, File handling (Reading and Writing Files, Organizing Files).

Data access and preparation

Understanding ndarrays: a multidimensional array object, creating ndarrays, data types for ndarrays, array arithmetic and element wise operation, basic indexing and slicing, reshaping and transposing arrays, universal functions: fast element-wise array functions, file input and output with arrays, introduction to pandas data structures, series, data frame.

Data import and export, indexing, filtering, and sorting data, handling missing data, string manipulation, data wrangling: merging, joining, reshaping data.

Exploratory data analysis

Descriptive analysis (Measures of central tendency, dispersion/variation, measure of location), computation of correlation coefficient, chi-square test for association between two categorical variables.

Data visualization

Basic libraries for data visualization. Introduction to Matplotlib, Basic plots using matplotlib, Specialized Visualization Tools using Matplotlib, *Seaborn:* Seaborn functionalities and usage.

Model development

Introduction to modeling libraries in python, introduction to statsmodels, scikit-learn.

Linear regression, multiple linear regression, binary logistic regression, ordinal logistic regression

READING LIST:

Johansson, R. (2019). *Numerical Python: Scientific computing and data science applications with NumPy, SciPy, and Matplotlib*. A Press.

Pine, D. J. (2019). *Introduction to Python for science and engineering*. CRC Press.

vanderPlas, J. (2017). *Python data science handbook: Essential tools for working with data*. O'Reilly Media.

Course Code: MSD C505

Course Title: PREDICTIVE ANALYTICS: THEORY AND PRACTICE

Credit: 2 **Hour: 30**
(Lecture: 2)

To introduce prediction-based modelling based on advanced regression analysis.

COURSE OUTCOMES:

- Formulate linear models in the field of data science.
- Fundamental knowledge of predictive models.
- Choose appropriate model by understanding nature of data and regression diagnostics.
- Test regression diagnosis and choose appropriate model using R and STATA

COURSE CONTENT:

Linear regression model

Revision, interpretation, assumption, Multiple regressions; partial correlation, relationship among simple, partial and multiple correlation coefficients; issues in multivariable regressions – multicollinearity, interaction, outliers; non-linearity; missing data; R2 and adjusted R2; omission of relevant variables and inclusion of irrelevant variables; multivariable regression with dummy explanatory variables; effect modifier.

Generalized regression model

Binary outcome: the logit, the probit, assumptions.
Categorical more than 2 responses: multinomial logistic, interpretation and assumption.
Ordinal: ordinal logistic regression with estimation, interpretation.
Count data: Poisson and negative binomial.

Fitting Regression in STATA/R

Linear regression model, Generalized regression model: Binary outcome, Categorical more than 2, response, ordinal, analysis of Count data.

Regression diagnostics in STATA/R

Postestimation commands for different regression analysis, residuals.

READING LIST:

Gandrud, C. (2020). *Reproducible research with R and R Studio* (3rd ed.). CRC Press.

Gujarati, D. N., & Sangeetha. (2007). *Basic econometrics* (4th ed.). Tata McGraw-Hill.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Pearson.

Johnson, R. A., & Wichern, D. W. (2020). *Applied multivariate statistical analysis* (8th ed.). Pearson.

Lander, J. P. (2017). *R for everyone: Advanced analytics and graphics*. Pearson Education.

Manly, B. F. J. (2016). *Multivariate statistical methods: A primer* (4th ed.). CRC Press.

Rencher, A. C. (2003). *Multivariate analysis: Methods and applications* (2nd ed.). Wiley-Interscience.

Rencher, A. C. (2015). *Methods of multivariate analysis* (2nd ed.). John Wiley & Sons.

Retherford, R. D., & Choe, M. K. (1993). *Statistical models for causal analysis*. Wiley-Interscience Publications.

Wickham, H. (2014). *Advanced R*. CRC Press.

Wickham, H., & Grolemund, G. (2016). *R for data science: Import, tidy, transform, visualize, and model data*. O'Reilly Media.

STATA Manual and help for regression diagnostics.

Course Code: MSD E501

Course Title: INTRODUCTION TO LONGITUDINAL DATA ANALYSIS

Credit: 3
(Lecture: 2, Tutorial: 1)

Hour: 45

COURSE OUTCOMES:

- Learn basic concepts and examples of longitudinal data.
- Learn models frequently used for analyzing longitudinal data.
- Learn longitudinal data analysis using STATA/SAS.

COURSE CONTENT:

Introduction and basic concepts

Exploring longitudinal data, Examples of longitudinal studies, Features and characteristics of longitudinal data statistics, Descriptive methods, Criteria, Causality, repeated measurements, Clustering, Missing data issues.

Examples of Longitudinal Data

Young Lives Study; Health and Retirement Study; British Cohort Study; India Human Development Survey

Linear Models

Overview of linear models, Distributional assumptions, Modelling the mean and covariance, Maximum likelihood estimation, Statistical inference, Variance and covariance, Fixed-effects models, Random-effects models, Baseline response, Biasness in mean and variance, Diagnostic and residual analysis

Generalized Linear Models (GLM)

Review of Generalized linear model (GLM), Moments and characteristic functions, Weighted GLM, Conditional GLM models, Estimation of Marginal models, Generalized Estimating Equations, Residual and diagnostics analyses.

Longitudinal Data Analysis using software

READING LIST:

Brown, H., & Prescott, R. (2015). *Applied mixed models in medicine*. John Wiley & Sons.

Davis, C. S. (2002). *Statistical methods for the analysis of repeated measurements*. Springer Science & Business Media.

Diggle, P., Heagerty, P., Liang, K. Y., & Zeger, S. (2002). *Analysis of longitudinal data*. Oxford University Press.

Fitzmaurice, G. M., Laird, N. M., & Ware, J. H. (2004). *Applied longitudinal analysis*. John Wiley & Sons.

Stroup, W. W. (2013). *Generalized linear mixed models: Modern concepts, methods, and applications*. CRC Press.

Weiss, R. E. (2005). *Modeling longitudinal data: With 72 figures*. Springer Science & Business Media.

West, B. T., Welch, K. B., & Gatecki, A. T. (2014). *Linear mixed models*. CRC Press.

Course Code: MSD E502

Course Title: SPATIAL ANALYTICS

Credit: 3 **Hour: 45**
(Lecture: 2, Tutorial: 1)

COURSE OUTCOMES:

- Understanding the concept of space and develop spatial dynamics in demographic process.
- Learning visualisation tools of demographic data and draw inferences.
- Learning different Geo-Spatial software to facilitate spatial analytical methods in demographic research.
- Learning Geographic Information System (GIS), spatial pattern analysis and spatial statistical techniquesto explain a specific spatial pattern.

COURSE CONTENT:

Concepts and Theories

Demography as a spatial science; difference between spatial demography and population geography; Spatial pattern and spatial process; location, distance and area; Distance and decay relationship and spatial hierarchy; space, place and region; Type of spaces- concrete and abstract space; absolute, relative and relational spaces.

Understanding demographic process by geographical scale; nature of disaggregated data- Census and secondary sources; Linking micro and macro demography in a spatial frame.

Application of spatial frameworks to demographic process; Space, culture and fertility; Spatial pattern of mortality and diseases; Distance as factor in access to health care and health planning; Migration and distance- gravity model; space, culture and migration; urban sprawl and sub-urbanization.

Statistical and Geospatial Data and Software

Spatial Concepts and Cartography: Spatial parameters: Site and location; Scale; Plane and spherical coordinate, Map Projection-UTM, Types of maps: cadastral, toposheet, thematic,

digital; Representation of spatial and non-spatial data; **Introduction to geospatial software:** *GIS:* discrete data: point, and polygon data,

Raster and vector data, layouts preparation. Geocoding and basics of digitization in *ArcGIS*

Introduction to Geoda: ESDA in (Exploratory Spatial Data Analysi); Local Indicators of Spatial Association (LISA)

Statistical Concepts: Bar diagram, Frequency polygon, Frequency curve; Test of significance, confidence intervals, Univariate and Multivariate Statistics: Correlation and Regression, Matrix algebra; Auto-correlation; kriging, Moran's I index

Introduction to Statistical software: SPSS, STATA, R

GIS and Spatial Analysis of demographic data

Representation of statistical data and automated cartography (Lab based exercises):

a) Population distribution map of India using dot and sphere/circle, cubes, combined; Cartograms
b) Density map by Choropleth and population density gradient by Isopleth;
c) Fertility, mortality and natural growth of population by Polygraph.
d) Measurement of population concentration by cumulative curve.
e) Migration flow by Carogram

Concept and application Models:

a) Spatial Lag and Error Regression Modeling;
b) Multilevel modeling (hierarchical linear modeling);
c) Geographically Weighted Regression;
d) Spatial Pattern Analysis;
e) Urban and city level projection

READING LIST:

Anselin, L. (2005). *Exploring spatial data with GeoDa: A workbook*. UC Santa Barbara, CA: Center for Spatially Integrated Social Science. Available at http://geodacenter.asu.edu/

Bailey, T., & Gatrell, A. C. (1995). *Interactive spatial data analysis*. Longman.

Bonham, C. G. F. (1995). *Information systems for geoscientists–Modeling with GIS*. Pergamon.

Chang, K. (2008). *Introduction to geographic information systems*. McGraw-Hill Education.

Chen, X., Orum, A. M., & Paulsen, K. E. (2013). *Introduction to cities: How place and space shape human experience*. Wiley-Blackwell.

de Castro, M. C. (2007). Spatial demography: An opportunity to improve policy making at diverse decision levels. *Population Research and Policy Review, 26*(5), 477–509.

Dorling, D., & Fairborn, D. (1997). *Mapping: Ways of representing the world*. Longman.

Griffith, D. A., & Amehein, P. (1997). *Multivariate statistical analysis for geographers*. Prentice Hall.

Kurland, K. S., & Gorr, W. L. (2007). *GIS tutorial for health*. ESRI Press.

Lo, C. P., & Yeung, A. K. W. (2002). *Concepts and techniques of geographic information systems*. Prentice Hall of India.

Paul, V. (2007). Demography as a spatial social science. *Population Research and Policy Review, 26*(5), 457–476. (plus Introduction to the special issue of PRPR on Spatial Demography), 455–456.

Reibel, M. (2007). Geographic information systems and spatial data processing in demography: A review. *Population Research and Policy Review, 26*(5), 601–608.

Robinson, A. H. H., Sale, R., Morrison, J., & Muehrcke, P. C. (1984). *Elements of cartography*. John Wiley & Sons.

Shaw, G., & Wheeler, D. (1994). *Statistical techniques in geographical analysis*. Prentice Hall.

Soja, E. W. (1996). *Third space: Journeys to Los Angeles and other real-and imagined places*. Wiley-Blackwell.

Course Code: MSD E511

Course Title: HEALTH SYSTEMS, AND POLICIES

Credit: 3
(Lecture: 2, Tutorial: 1) **Hour: 45**

COURSE OUTCOMES:

- To develop capacity among students to analyze health systems from an international and comparative perspectives.
- To provide a historical orientation to the students on Indian-scenario; national health policy, health care delivery system, national health programmes and health sector reforms.
- To understand the need and relevance of health legislations as an instrument of protection and promotion of public health and inculcate the ability to critically review them.
- To introduce the students to health policy and systems research, and recent developments.

COURSE CONTENT:

Basic Concepts: Concepts of Health; Public health; Community health; Preventive and curate health; Health promotion; Health services; and Primary, secondary and tertiary care.

Health System: Goals, boundaries, functions, and WHO's health system building blocks: service delivery, health workforce, health Information systems, access to essential medicines, financing and leadership/ governance.

Health Services: Basic models and functions of health services, international experiences and goals and elements in universal health care (UHC) approach.

Health care system in India: public sector, private sector, voluntary sector, human resources for health, access to health care, utilisation and expenditure on health services, and UHC initiatives and challenges ahead.

Health policy: Concepts and tools of health policy, health policy stakeholders, health policy triangle framework, rational decision making to approach to health policymaking,

introduction to health policy and systems research.

Health policymaking in India: Health planning in post-Independent India, national health policies, national health policy 2017, and current national health programmes.

Regulation in the health sector: Need for regulations, mechanisms for regulation, key legislations and standards in the health sector in India, and challenges in the implementation of regulations.

READING LIST:

Abel-Smith, B. (2018). *An introduction to health: Policy, planning and financing*. Routledge.

Balarajan, Y., Selvaraj, S., & Subramanian, S. V. (2011). Health care and equity in India. *The Lancet, 377*(9764), 505–515. https://doi.org/10.1016/S0140-6736(10)61894-6

Central Bureau of Health Intelligence. (2021). *National health profile 2021* (or the latest year). New Delhi: Central Bureau of Health Intelligence, Ministry of Health and Family Welfare, Government of India.

Gilson, L., & World Health Organization. (2013). *Health policy and system research: A methodology reader: The abridged version*. World Health Organization.

Government of India. (2017). *National health policy-2017*. Ministry of Health and Family Welfare, Government of India.

Mossialos, E., Wenzl, M., Osborn, R., & Sarnak, D. (2016). 2015 international profiles of health care systems. Canadian Agency for Drugs and Technologies in Health.

Montagu, D., & Goodman, C. (2016). Prohibit, constrain, encourage, or purchase: How should we engage with the private healthcare sector? *The Lancet, 388*(10044), 613–621. https://doi.org/10.1016/S0140-6736(16)30374-X

Murray, C. J. L., & Evans, D. B. (2003). Health systems performance assessment: Goals, framework, and overview. In *Health systems performance assessment: Debates, methods and empiricism* (pp. 3–23). World Health Organization.

Murray, C. J. L., & Frenk, J. (2000). A framework for assessing the performance of health systems. *Bulletin of the World Health Organization, 78*(6), 717–731.

Nandraj, S., Gupta, P., & Randhawa, S. (2021). *Regulation of health care delivery in India: A landscape study*. Health Systems Transformation Platform, New Delhi.

National Statistical Office. (2019). *Key indicators of social consumption: Health (July 2017–June 2018)*. Ministry of Statistics and Programme Implementation, Government of India.

Peters, D. H. (2018). Health policy and systems research: The future of the field. *Health Research Policy and Systems, 16*(1), 1–4. https://doi.org/10.1186/s12961-018-0291-4

Rao, K. S. (2016). *Do we care?: India's health system*. Oxford University Press.

Walt, G., & Gilson, L. (1994). Reforming the health sector in developing countries: The central role of policy analysis. *Health Policy and Planning, 9*(4), 353–370. https://doi.org/10.1093/heapol/9.4.353

World Health Organization. (2018). *A vision for primary health care in the 21st century: Towards universal health coverage and the Sustainable Development Goals* (No. WHO/HIS/SDS/2018.15). World Health Organization.

Course Code: MSD E512

Course Title: URBANIZATION, SPACE AND PLANNING

Credit: 3 **Hour: 45**
(Lecture: 2, Tutorial: 1)

COURSE OUTCOMES:

- Developing a comprehensive understanding on concepts of space, place and region.
- Understanding the history of urban planning and its illustration in Indian context.
- Acquainting students with theories of regional development and various strategies of regional planning.
- Developing a critical understanding on urban policies and progammes in India
- Providing students, a practical knowledge of Geographical Information Systems and its utility in regional and urban planning.

COURSE CONTENT:

Urbanization and Space

Urbanization and space: Definitions and concepts of urban areas & urbanization. Concepts and forms of formal and informal spaces; Differences between space, place and region; urbanization and space interaction: gravity model, distance decay model, forces of concentration and dispersion, urban agglomeration and spatial economy; Access and right to the city

Evolution of Spaces of Settlements

Settlement: evolution, characteristics and factors; settlement pattern and hierarchy; Urban morphology; Change in urban land use and population density; Rural-urban relationship: dichotomy or continuum; Role of urban centres in rural development.

Urban and Regional Planning

Planning: Definitions, concepts, purpose, types and levels; geography/demography and planning relationship.

Regional development/planning: Region: concept and definition, types (formal, functional

and planning); Need for regional planning; Types of regional planning; Spatial structure of regions,

Theories of regional development: Stages of development, economic base theory, Industrial location theory, Growth Pole theory; Core-periphery interactions.

Regional planning in India; Planning regions in India; Regional disparity in development; causes and consequences, North-Eastern regional council, Mumbai Metropolitan Regional Development Plan.

Urban Planning: Concepts; history and origins of urban planning; pioneers of urban planning; types of urban plans: New towns, neighborhood, garden city, green belts; healthy urban planning, WHO concept of healthy city, livable city, sustainable city.

Urban policy since independence, important urban plans (New Delhi, Navi Mumbai, Chandigarh, Gandhinagar, Bhubaneshwar); Smart Cities Mission; HRIDAY, AMRUT, PURA, RURBAN mission

Challenges in Urban planning

Recent urban policies and programmes; Urban redevelopment; Urban poverty, urban housing and real estate, Slums and slum rehabilitation, The case of Slum Rehabilitation Authority (SRA) in Mumbai; Urban pollution, Solid waste management; Management of migrants

Remote Sensing, GIS and Urban and Regional Planning

Application of Remote Sensing and GIS in urban and regional planning.

READING LIST:

Bhagat, R. B., Roy, A. K., & Sahoo, S. (2020). *Migration and urban transition in India: A development perspective*. Routledge India.

Chand, M., & Puri, V. K. (1983). *Regional planning in India*. Allied Publishers Private Ltd.

Chaudhuri, J. R. (2001). *An introduction to development and regional planning*. Orient Longman.

Friedman, J. (1964). *Regional development and planning: A reader*. The MIT Press.

Friedman, J. (1966). *Regional development policy: A case study of Venezuela*. MIT Press.

Friedman, J., & Alonso, W. (1964). *Regional development and planning: A reader*. The MIT Press.

Friedman, J., & Weaver, C. (1979). *Territory and function: The evolution of regional planning*. Edward Arnold.

Ginsburg, N., Koppel, B., & McGee, T. G. (1991). *The extended metropolis: Settlement transition in Asia*. University of Hawaii Press.

Hall, P. (1992). *Urban and regional planning* (3rd ed.). Routledge.

Harvey, D. (2012). *Rebel cities: From the right to the city to the urban revolution*. Verso.

Husain, M. (1994). *Human geography*. Rawat Publishing.

Kawashima, T., & Korcelli, P. (1982). *Human settlement systems: Spatial patterns and trends*. IIASA.

Knowles, R., & Warling, J. (1983). *Economic and social geography: Made simple*. Heinemann.

Kumar, A., & Bhagat, R. B. (2021). *Migrants, mobility and citizenship in India*. Routledge India.

Leong, G. C., & Morgan, G. C. (1982). *Human and economic geography*. Oxford University Press.

Lo, C. P., & Yeung, A. K. W. (2002). *Concepts and techniques of geographic information systems*. Prentice Hall of India.

Mishra, R. P. (1992). *Regional planning: Concepts, techniques, policies and case studies*. Concept Publishing Co.

MMRDA. (2016). *Mumbai Metropolitan Regional Development Plan 2016-2036*. MMRDA.

Nath, V. (1971). Regional development policies. *Economic and Political Weekly, 6*(30–32), 1601–1608.

Nyerges, T. L., & Jankowski, P. (2010). *Regional and urban GIS: A decision support approach*. Rawat Publication.

Singh, R. Y. (1994). *Geography of settlements*. Rawat Publications.

Sarin, M. (1982). *Urban planning in the third world: The Chandigarh experience*. Manshell.

UNEP & others. (2007). *Livable cities: The benefits of environmental planning*. The Cities Alliance. http://www.citiesalliance.org/index.html

SEMESTER III

Course Code: IKS 501

Course Title: INDIAN KNOWLEDGE SYSTEM-2

Credit: 02
(Lecture: 2)

Hours: 30

Under process

Course Code: MSD C506

Course Title: ETHICS IN RESEARCH AND PUBLICATIONS

Credit: 2 **Hour: 30**
(Lecture: 2)

COURSE OUTCOMES:

- Aware of different types of publications, search engines, copyrights.
- Understand research, publication and data ethics.

COURSE CONTENT:

Philosophy of Research

Research Publications

Overview of different types of research articles: -primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, journals, books, publishers, impact factor, reference style

Ethics in Research

Ethics of Research, History of ethical guidelines and general principles Informed consent and human subject protection ICMR ethical guidelines for biomedical research on human participants The Biomedical research on human subjects -regulation, control and safeguards

Ethical consideration in Data Collection: Informed Consent, approvals from institution review board

Ethics in Data Analytics/computing

Data obfuscation, encryption, confidential computing, privacy implementation, data manipulation

Scientific Misconduct and Publication ethics

falsification, fabrication, and plagiarism, Selective reporting and misrepresentation of data. practices/standards setting initiatives and guidelines, Conflict of interest, Violation of publication ethics, copyright and sharing policies

READING LIST:

Bernard, H. R. (1995). *Research methods in anthropology: Qualitative and quantitative approaches*. Altamira Press.

Goode, W. J., & Hatt, P. K. (1952). *Methods in social research*. McGraw-Hill.

Kish, L. (1995). *Survey sampling*. John Wiley & Sons, Inc.

Lohr, S. L. (1999). *Sampling: Design and analysis*. Duxbury Press.

Mukherji, P. N. (1999). *Methodologies in social science*. Sage Publications.

Singleton, R. A., & Straits, B. C. (1999). *Approaches to social research*. Oxford University Press.

Young, P. V. (1994). *Scientific social surveys and research* (4th ed.). Prentice-Hall.

Course Code: MSD C507

Course Title: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING APPLICATIONS

Credit: 3
(Lecture: 2, Tutorial:1)

Hour: 45

To provide conceptual knowledge and applications of AI and ML.

COURSE OUTCOMES:

- Describe the concepts of AI and machine learning
- Visualize the applications of AI and ML in public health interventions and data analytics
- Apply the machine learning tools in data science.
- Develop technological foundation of cloud computing

COURSE CONTENT:

Basic concepts of Big Data: Concept of Big Data, 5Vs, Data Science, Machine Learning (ML), Deep learning (DS), Artificial Intelligence (AI). Survey data vs. digital data – advantages and disadvantages

Application of AI for planning and monitoring of public health and welfare programmes, Healthcare informatics, Telemedicine, digital health, surveillance. Chatbots

Relational Database Management Systems: SQLite with R, MariaDB with R on amazon EC2 instance, PostgreSQL with R on amazon RDS.

Digital trace data and cloud computing: Digital trace data from social media, websites, Introduction to Cloud Computing, Migrating into a Cloud, Monitoring, Management and Applications, Data Security in the Cloud, Legal Issues in Cloud computing.

Machine Learning: concepts, Types of machine learning – supervised, unsupervised, reinforcement learning. Regression vs. classification problem, algorithm vs models, Basics of machine learning model building, train-test split, model evaluation, ROC curves, application of machine leaning in health, public health and demography, Advantages and disadvantages of

ML.

Models in machine learning –Basics of Decision Trees, trees vs linear models, Random Forest, fitting of classification and regression trees, support vector machines, Clustering (K-nearest neighbours, PCA), Neural Networks.

READING LIST:

Alpaydin, E. (2005). *Introduction to machine learning*. PHI.

Burger, S. V. (2018). *Introduction to machine learning with R: Rigorous mathematical modeling*. O'Reilly.

Doss, A. (2013). *Cloud computing*. Tata McGraw Hill.

Lewis, N. D. (2017). *Machine learning made easy with R: An intuitive step-by-step blueprint for beginners*. CreateSpace Independent Publishing Platform.

Lantz, B. (2019). *Machine learning with R: Expert techniques for predictive modeling* (3rd ed.). Packt Publications.

Mitchell, T. (1997). *Machine learning*. McGraw Hill.

Ng, A. (n.d.). *Machine learning yearning*. Retrieved from https://nessie.ilab.sztaki.hu/~kornai/2020/AdvancedMachineLearning/Ng_MachineLearningYearning.pdf

Rittinghouse, J. W., & Ransome, J. F. (2009). *Cloud computing: Implementation, management, and security*. CRC Press.

Russell, S., & Norvig, P. (2010). *Artificial intelligence: A modern approach* (3rd ed.). Prentice Hall.

Vecciola, B., & Selvi. (2017). *Mastering cloud computing: Foundations and applications programming*. Tata McGraw Hill.

Course Code: MSD C508

Course Title: APPLIED MULTIVARIATE ANALYSIS

Credit: 2
(Lecture: 2)

Hour: 30

COURSE OUTCOMES:

- Become aware about the advanced multivariate models.
- Capable of estimating and interpreting advanced multivariate models.
- Capable of estimating and interpreting multilevel models.
- Learn other multivariate techniques

COURSE CONTENT:

Review of Multiple Linear Regression Analysis and its Assumptions

Advanced Multivariate Techniques

a) *Simultaneous equation models:* the identification problem. Methods of estimation-the instrumental variable method and two-stage-least squares method. Diagnostic checking and model selection

b) *Generalized linear models:* A general model for the response probability, the logit, the probit and the complementary log –log model, choice of link function, Estimation of the generalized model. Latent variable representation of a generalized linear model.

c) *Revision and extended to binary outcome:* Structure Equation Modelling, Structural Approach to evaluate the policies/programs, IV-method, structural equation modeling (with an application of latent class models to methodological studies of measurement error),

d) *Multilevel modelling:* A multilevel model for group effects, estimating group effects, random vs. fixed effects, random intercept model

e) Generalized linear random intercept model, random intercept logit model, a random slope logit model

f) Multilevel and marginal modeling techniques for clustered or longitudinal data (with applications to methodological studies of interviewer effects and modeling trends in the NFHS/LASI survey), two-level random intercept model,

g) Concept of Bayes theorem and development of regression techniques based on Bayes concept and its application

h) Computer Applications using Stata and MLwiN softwares

READING LIST:

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Pearson.

Johnson, R. A., & Wichern, D. W. (2020). *Applied multivariate statistical analysis* (8th ed.). Pearson.

Manly, B. F. J. (2016). *Multivariate statistical methods: A primer* (4th ed.). CRC Press.

Rencher, A. C. (2003). *Multivariate analysis: Methods and applications* (2nd ed.). Wiley-Interscience.

Rencher, A. C. (2015). *Methods of multivariate analysis* (2nd ed.). John Wiley & Sons.

Sharma, S. (2018). *Applied multivariate techniques* (2nd ed.). Wiley.

Course Code: MSD C509

Course Title: PROGRAM MONITORING AND EVALUATION DESIGN

Credit: 3
(Lecture: 2, Tutorial:1) **Hour: 45**

COURSE OUTCOMES:

- Develop M & E framework and Statistical Analysis Plan
- Demonstrate an understanding of the essential principles and design of Program evaluation
- Learn statistical methods used in evaluation Program
- Understand Ethical issues in evaluation research
- Understand public interventions related to health and family welfare

COURSE CONTENT:

Introduction to Monitoring and Evaluation

Basic concepts, Difference between Monitoring and Evaluation; Linkage between Planning, Monitoring and Evaluation; Importance of Monitoring and Evaluation, Databased decision making.

Monitoring and Evaluation Framework

Resources for monitoring and evaluation, Engagement of stakeholders in monitoring and evaluation; Meaning of Indicators, Ideal requirement, process of developing indicator, illustration of indicators developed from large scale surveys, measurement, need & levels of indicator; Challenges in developing indicators from Large-Scale Surveys; Types of Indicators – Input, Process, Output, Outcome, Impact; Learning and accountability of Monitoring and evaluation data.

Monitoring of Policy Implementation

Components of policy and programme, budget, staff, process of evaluation, developing tangible indicators for policy monitoring in terms of Input, Process, Output, Outcome, Impact; Result based inference.

Evaluation in Theory

Principles, norms and standards for evaluation; Criterion for evaluation; Theory of Change; Evaluating for results; Roles and responsibilities in evaluation; Scaling Impact.

Evaluation Design

Determination of sample size under different approaches and design including measurement of change due to certain interventions; Quasi Experiment design, Case control design, Evaluation Terms of Reference, Formative and Summative Evaluations, Managing Evaluations; Evaluation at different points: Baseline, Mid-point, Concurrent and End line evaluation; Randomization, Statistical design of Randomization; Randomized control trials, time dependent cluster design, interrupted time series analysis.

Assuring the Quality of Evaluation Design and Methodology

Overview; Defining the context; The evaluation purpose; Focusing the evaluation; Evaluation methodology; Mandatory requirements for programme; SWOT analysis of NHM, ICDS and National Livelihood Mission; Social audit – meaning, objectives, advantage, case study of social audit.

Statistical Approaches of Evaluation of Intervention Programme

Statistical inferences used in different intervention design – z, t, F and paired 't' tests, two stage LSM, instrument variable method; Propensity score matching; Difference in Difference Method: Theory and application, advantage and disadvantage, regression implementation, Decomposition analysis

Healthcare Informatics

MIS – Monitoring information system; Role of programmers; HMIS system; Global Positioning System, Management Information System and Use of Technology, Use of Artificial Intelligence, tele-interventions, Use of spatial data.

Group work and presentation on Health and family welfare Program evaluation

Review program, SWOT analysis, preparing M&E framework/choosing framework indicators and methods for evaluation.

READING LIST:

Casley, D. J., & Kumar, K. (1988). *The collection, analysis, and use of monitoring and evaluation data*. The John Hopkins University Press.

Family Health International. (2004). *Introduction to monitoring and evaluation monitoring HIV/AIDS programs: A facilitator's training guide*. Family Health International.

GoI, & UNDP. (2012). *Guiding framework for monitoring and impact evaluation of capacity building & training of Panchayati Raj Institutions in states/UTs*. Government of India and United Nations Development Programme.

International Federation of Red Cross and Red Crescent Societies (IFRC), & Red Cross Society (RCS). (2002). *Handbook for monitoring and evaluation*. IFRC.

McLean, R., & Gargani, J. (2019). *Scaling impact innovations for the public good*. Routledge.

National Institute of Rural Development & Panchayati Raj (NIRD&PR), Ministry of Rural Development (MoRD), & Tata Institute of Social Sciences (TISS). (2016). *Social audit: A manual for trainers*. NIRD&PR, MoRD, & TISS.

Organisation for Economic Co-operation and Development (OECD). (2021). *Applying evaluation criterion thoughtfully*. OECD Publishing. https://doi.org/10.1787/543e84ed-en.

Rossi, P. H., Lipsey, M. W., & Freeman, H. E. (2004). *Evaluation: A systematic approach* (7th ed.). Sage Publications.

Sullivan, T. M., Strachan, M., & Timmons, B. K. (2007). *Guide to monitoring and evaluating health information products and services*. Center for Communication Programs, Johns Hopkins Bloomberg School of Public Health; Constella Futures; Management Sciences for Health.

United Nations Development Group. *The theory of change: UNDAF companion guideline*. United Nations Development Group.

Course Code: MSD C510

Course Title: ANALYSIS OF COMPLEX SURVEY AND ESTIMATION

Credit: 2 **Hour: 30**
(Lecture: 1, Tutorial:1)

It aims to equip students with advanced knowledge and practical skills in survey research and data analytics, enabling them to design, implement, and analyze complex survey data effectively. Students will gain expertise in sampling techniques, survey weighting, estimation of the indicators & its variance and hands-on data analysis using Stata and R. By learning these skills, students for careers in survey research, data analytics, and analysis of large-scale data, making them valuable professionals in research organizations, government, and academia.

COURSE OUTCOMES:

- A strong foundation in sampling techniques, survey weighting, estimation of the indicator and its variance to improve the quality of large-scale surveys.
- Able to handle real-world survey challenges, such as designing of the new survey align with the objectives of the research, weight computation, estimation of the interest variable and its standard error.
- Hands-on experience with statistical software (Stata and R) for survey data analysis using complex and large scale survey data

COURSE CONTENT:

Introduction to Complex Sampling

a) Introduction of Sampling Frame: Dual Sampling Frame, Imperfect Sampling Frame.
b) Multistage Sampling and Probability Proportional to Size Sampling
c) Concept of Intraclass correlation (ICC) and Design Effects in Complex Sampling.
d) Unequal Probability Sampling in multistage design: Hansen-Hurwitz estimator, Des Raj Estimator, Horvitz-Thompson estimator

An Overview of National and International Surveys Design

a) National Family Health Survey (NFHS), Demographic Health Surveys (DHS)
b) Periodic Labour Force Survey (PLFS) & Health Round of the National Sample Survey Office (NSSO) Surveys

c) Longitudinal Ageing Study in India (LASI)

d) Indian Human Development Survey (IHDS)

e) Multiple Indicator Cluster Survey (MICS)

f) Sampling Strategies in Large-Scale Surveys

g) Implementation of Stratification at PSU vs Higher levels: Challenges and best practices

Weight Computation in Complex Surveys

a) Concept of Survey Weights: Design Weights, Adjustment Weights, Calibration Weights, Self-weighted Design, Normalised weight, De-Normalised weight

b) Post-Stratification and Raking Adjustments

c) Handling Non-Response in Survey Weights

d) Weighting Procedures in NFHS, LASI. MICS and Health round of NSSO Surveys

Standard Error Estimation in Complex Surveys

a) Variance Estimation in Stratified and Cluster Sampling

b) Taylor Series Linearization

c) Application of Bootstrap, Balanced Repeated Replication (BRR) and Jackknife Method

Non-sampling errors

a) Sources of Survey Errors

b) Sources of Nonresponse

c) Social Desirability Bias

d) Randomized Response Techniques to Handle Sensitive Questions-Mirrored Methods, Forced Response Design, Disguised Response Design and Unrelated Question Design

Hands on Training Exercise

a) Hands-on on Weight computation of Complex Survey

b) Computation of Standard Error using STATA, R

READING LIST:

Groves, R. M., Fowler, F. J. Jr., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2011). *Survey methodology* (2nd ed.). Wiley.

Heeringa, S. G., West, B. T., & Berglund, P. A. (2017). *Applied survey data analysis* (2nd ed.). Chapman and Hall/CRC.

Kish, L. (1965). *Survey sampling*. John Wiley & Sons.

Longitudinal Ageing Study in India (LASI), India Report; Wave -1

Levy, P., & Lemeshow, S. (2015). *Sampling of populations: Methods and applications* (5th ed.). Wiley.

National Family Health Survey (NFHS-5), 2019-21: India: Volume II. Mumbai: IIPS.

Periodic Labour Force Survey (PLFS) – Annual Report July, 2023 – June, 2024

Roy, T. K., Acharya, R., & Roy, A. K. (2016). *Statistical survey design and evaluating impact*. Cambridge University Press.

Särndal, C.-E., Swensson, B., & Wretman, J. (1992). *Model assisted survey sampling*. Springer.

Statistical Survey Design and Evaluating Impact by Tarun Kumar Roy, Rajib Acharya, Arun Kumar Roy (2016).

UNICEF. *Multiple Indicator Cluster Surveys (MICS)*.

Course Code: MSD C511

Course Title: PROJECTIONS AND FORECASTING

Credit: 3
(Lecture: 2, Tutorial:1)

Hour: 45

To acquaint students to carry out projections, and forecast independently and apply them with real data.

COURSE OUTCOMES:

- Demonstrate the concepts of time series analysis, projection and forecast
- Understand demographic, mathematical and statistical methods of projections
- Forecasts with valid conclusions based on appropriate time series data.

COURSE CONTENT:

Time series analysis

significance of time series analysis, Nature of time series data, measures of dependence, assumption, and component (stationary non-stationary), vector-valued and multidimensional series, moving average, smoothing in the time series context, autoregressive model, ARMA, ARIMA, application in forecast.

Concept of Projections and forecast

basic concepts and need for projections, forecast, time series analysis, different approaches of projections and forecast: mathematical, time series, regression based, simulation, period vs cohort, building scenarios, expert opinion.

Population Estimates and Projections

Concepts of population projections; population estimates, forecasts and projections, uses of population projections.

Methods of interpolation; extrapolation using linear, exponential, polynomial, logistics, Gompertz curves and growth rate models.

Cohort component method: basic methodology; projection of mortality, fertility and

migration components; population projections of United Nations, World Bank and Expert Committees of Government of India; accuracy of population projections. Methods of rural-urban and sub-national population projections.

Mortality Forecasts

Lee-carter model, ARIMA model, cause specific mortality.

Methods of socio-economic projections

labour force projections, school-enrolment, health personnel and households. Multi-state projections and forecasting, Age-Period-Cohort methods.

READING LIST:

Box, G., Jenkins, G. M., Reinsel, G. C., & Ljung, G. (2016). *Time series analysis: Forecasting and control* (5th ed.). Wiley.

Montgomery, D. C., Jennings, C., & Kulahci, M. (2016). *Introduction to time series analysis and forecasting* (2nd ed.). Wiley.

Navaneetham, K., & Groenewold, G. (1998). *The projection of populations: Data appraisal, basic methods and applications*. Population and Sustainable Development Teaching Texts. Centre for Development Studies.

Shumway, R. H., & Stoffer, D. S. (2017). *Time series analysis and its applications: With R examples* (4th ed.). Springer.

Smith, S. K., Tayman, J., & Swanson, D. A. (2001). *State and local population projections: Methodology and analysis*. Kluwer Academic/Plenum Publishers.

Course Code: MSD E521

Course Title: BAYESIAN AND SMALL AREA ESTIMATION METHODS

Credit: 3
(Lecture: 2, Tutorial:1)

Hour: 45

This syllabus provides a comprehensive introduction to Bayesian statistics, covering both theoretical foundations and practical applications. The course begins with fundamental Bayesian concepts, including Bayes' theorem, prior distributions, and posterior inference. It then introduces computational techniques such as Markov Chain Monte Carlo (MCMC) methods, followed by Bayesian regression models, including hierarchical modeling. A key component of the course is Small Area Estimation (SAE), exploring direct and model-based methods, with a focus on Bayesian approaches. Hands-on exercises using real-world data from large-scale surveys such as NFHS will be integrated throughout the course.

COURSE OUTCOMES:

- Build a strong foundation in Bayesian statistical methods, including prior distributions, posterior inference, and credible intervals.
- Introduced computational techniques such as Markov Chain Monte Carlo (MCMC), Gibbs sampling, and Metropolis-Hastings algorithms for Bayesian estimation.
- Students are equipped with the skills to apply Bayesian regression models, including hierarchical and logistic regression, in social sciences and health research.
- Understand Small Area Estimation (SAE) techniques, including Bayesian approaches, and their applications in large-scale household surveys.
- Hands-on experience with Bayesian statistical analysis using software tools like R and STATA, ensuring students can apply these methods to real-world data.
- To prepare students for careers in survey research, data analytics, and policy evaluation by strengthening their ability to analyze complex datasets using Bayesian methods.

COURSE CONTENT:

Introduction to Bayesian Statistics

a) Introduction to Bayes' theorem
b) Differences between Frequentist and Bayesian approaches
c) Priors, likelihood, and posterior distributions
d) Conjugate priors and credible intervals

Computational Methods

a) Introduction to Markov Chain Monte Carlo (MCMC)
b) Gibbs Sampling and Metropolis-Hastings Algorithm

Bayesian Regression

a) Bayesian linear and logistic regression
b) Multi-level models in Bayesian statistics
c) Applications in social sciences and health research
d) Model selection using Bayes factors in survey research, epidemiology, and machine learning

Small Area Estimation (SAE) Techniques

a) Need and introduction to SAE
b) Direct vs. Indirect vs Model based Estimation Methods and its implications
c) Area-Level and Unit-Level Models (Fay-Herriot Model, Empirical Best Linear Unbiased Prediction - EBLUP)
d) Bayesian Approaches in SAE
e) SAE Applications in NFHS and Other Household Surveys

Hands on Exercise

a) Exercise on Unit 2, Unit 3, Unit 4 using software R , STATA etc.

READING LIST:

Bolstad, W. M., & Curran, J. M. (2016). *Introduction to Bayesian statistics* (3rd ed.). Wiley.

Brewer, B. J. (n.d.). *Introduction to Bayesian statistics*. Material, Auckland University.

Datta, G. S., & Ghosh, M. (2012). Small area shrinkage estimation. *Statistical Science, 27*(1), 95-114. https://doi.org/10.1214/11-STS368

Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., & Rubin, D. B. (2013). *Bayesian data analysis* (3rd ed.). CRC Press.

Gelman, A., & Hill, J. (2006). *Data analysis using regression and multilevel/hierarchical models*. Cambridge University Press.

Ghosh, M., & Rao, J. N. K. (1994). Small area estimation: An appraisal. *Statistical Science, 9*(1), 55-93. https://doi.org/10.1214/ss/1177012295

Hoff, P. D. (2009). *A first course in Bayesian statistical methods*. Springer.

Jackman, S. (2009). *Bayesian analysis for the social sciences*. Wiley.

Kruschke, J. K. (2014). *Doing Bayesian data analysis: A tutorial with R, JAGS, and Stan*. Academic Press.

McElreath, R. (2020). *Statistical rethinking: A Bayesian course with examples in R and Stan* (2nd ed.). CRC Press.

Pfeffermann, D., & Rao, C. R. (2009). *Handbook of statistics, volume 29B: Sample surveys – Inference and applications to small area estimation*. Elsevier.

Pratesi, M. (2016). *Analysis of poverty data by small area estimation*. Wiley.

Rao, J. N. K., & Molina, I. (2015). *Small area estimation* (2nd ed.). Wiley.

Robert, C. P. (2007). *The Bayesian choice: From decision-theoretic foundations to computational implementation*. Springer.

Course Code: MSD E522

Course Title: CONCEPTS AND MEASURES OF GLOBAL HEALTH

Credit: 3
(Lecture: 2, Tutorial:1)

Hour: 45

This paper introduces to the students the basic concepts of global health. This course emphasizes on understanding the global burden of disease and measuring population health. A key component of this course is to understand the determinants of health and health disparities. It will also provide student with a broad understanding of the relationship between environment and health. It also develops the understanding of the students about the health care delivery system, human resources for health, migration of human resources for health, etc. Finally, it introduces to students the issues related to policy and health.

COURSE OUTCOMES:

- To familiarize the students with the emerging concepts, measures, and significance of global health in contemporary world.
- To understand the global mortality transition in terms of it varied features like cause of death, population age structure and differential quality of life.
- To understand the impact of poverty, inequality on disease prevalence, health infrastructure, deprivation for the mortality divides and its repercussions.
- To introduce and understand impacts of environmental factors and recommend public health measures need to be taken to mitigate health effect of climate change.
- To recommend appropriate public health intervention in keeping with disease burden and evaluate health system performance in international perspective.

COURSE CONTENT:

Concept and introduction

Concept of global health; why is it important to study global health?; health and development in the global context; demographic, health and epidemiological transitions; major patterns of

distribution of disease in the world; sources of data on disease and disability.

Global burden of disease

Concept of burden of disease; hypotheses related to burden of diseases – compression of morbidity, expansion of morbidity and dynamic equilibrium; measures of burden of disease at the population level – health expectancy and health gap; methods for estimating DFLE, HALE and DALY; how does the burden of disease and mortality vary by geography, social class, race and gender? GBD 1990, 2010 and 2013 – changes and continuities; new and re-emerging infectious diseases; issues related to HIV/AIDS; introduction to NCDs; double burden of diseases in developing countries; impact of tobacco abuse; trends and challenges related to maternal and child health; maternal mortality.

Determinants of Health

Culture, gender, race, social, political and economic determinants of health and health disparities; contribution of income, education and other factors to health; Factors responsible for variation in the global burden of disease across countries; poverty and health; income inequality and health; health risk factors.

Environment and health

Role of water, sanitation, indoor and outdoor air pollution and nutrition in explaining global health disparities; climate change and health; migration, disaster (man-made, natural), conflicts and epidemics.

Health care delivery systems

Introduction to health systems; how to measure performance of health system?; health systems in different countries; factor responsible for better performance of health systems in developed countries; the distribution of human resources for health; quality of human resources for health; the push and pull factors associated with the migration of health care providers.

Policy and health

Human rights approach to health; national and international policies related to health; how are global health priorities set?; the role of international actors like WHO, World Bank, etc.

in global health; influence of international priorities on national priorities.

READING LIST:

Anand, S., & Baernighausen, T. (2004). Human resources and health outcomes: A cross-country econometric study. *Lancet, 364*(9445), 1603-1609. https://doi.org/10.1016/S0140-6736(04)17105-6

Box, G., Jenkins, G. M., Reinsel, G. C., & Ljung, G. (2016). *Time series analysis: Forecasting and control* (5th ed.). Wiley.

Brown, T. M., Cueto, M., & Fee, E. (2006). The World Health Organization and the transition from 'international' to 'global' public health. *American Journal of Public Health, 96*(1), 62-72. https://doi.org/10.2105/AJPH.2005.074148

Chen, L., et al. (2004). Human resources for health: Overcoming the crisis. *Lancet, 364*(9449), 1984-1990. https://doi.org/10.1016/S0140-6736(04)17459-3

Cutler, D., Deaton, A., & Lleras-Muney, A. (2006). The determinants of mortality. *Journal of Economic Perspectives, 20*(3), 97-120. https://doi.org/10.1257/jep.20.3.97

Gwatkin, D. R. (2000). Health inequalities and the health of the poor: What do we know? What can we do? *Bulletin of the World Health Organization, 78*(1), 3-18. https://doi.org/10.1590/S0042-96862000000100002

Hsiao, W. C. (2003). What is a health system? Why should we care? *Harvard School of Public Health Working Paper*.

Jacobsen, K. H. (2007). *Introduction to global health*. Jones and Bartlett.

Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease. *Journal of Health and Social Behavior, 35*, 80-94. https://doi.org/10.2307/2626958

London, L. (2008). What is a human-rights approach to public health? *Health and Human Rights, 10*(2), 123-135.

Markel, W. H., Fisher, M., & Smego, R. (2007). *Understanding global health*. McGraw Hill.

Merson, M. H., Black, R. E., & Mills, A. J. (2001). *International public health: Diseases, programs, systems, and policies*. Aspen Publishers.

Mills, A., Rasheed, F., & Tollman, S. (2006). Strengthening health systems. In *Disease control priorities in developing countries* (2nd ed., pp. 87-102). Oxford University Press.

Murray, C. J. L., Frenk, J. (2000). A framework for assessing the performance of health systems. *Bulletin of the World Health Organization, 78*(6), 717-731. https://doi.org/10.1590/S0042-96862000000600002

Murray, C. J. L., Salomon, J. A., Mathers, C. D., & Lopez, A. D. (2002). *Summary measures of population health: Concepts, ethics, measurement, and applications*. The World Health Organization.

Pallikadavath, S., Singh, A., Ogollah, R., Dean, T., & Stones, W. (2013). Human resource inequalities at the base of India's public health care system. *Health & Place, 23*, 26-32. https://doi.org/10.1016/j.healthplace.2013.05.003

Ravishankar, N., et al. (2009). Financing of global health: Tracking development assistance for health from 1990-2007. *Lancet, 373*(9681), 2113-2124. https://doi.org/10.1016/S0140-6736(09)60909-3

Ruger, J. P. (2005). The changing role of the World Bank in global health. *American Journal of Public Health, 95*(1), 60-70. https://doi.org/10.2105/AJPH.2004.059490

Shiffman, J. (2009). A social explanation for the rise and fall of global health issues. *Bulletin of the World Health Organization, 87*(8), 608-613. https://doi.org/10.2471/BLT.08.059360

Smith, J. P. (1999). Healthy bodies and thick wallets: The dual relation between health and economic status. *Journal of Economic Perspectives, 13*(2), 145-166. https://doi.org/10.1257/jep.13.2.145

Zurn, P., Dal Poz, M. R., Stilwell, B., & Adams, O. (2004). Imbalance in the health workforce. *Human Resources for Health, 2*(13), 1-12. https://doi.org/10.1186/1478-4491-2-13

Course Code: MSD E523

Course Title: DEMOGRAPHIC MODELS AND INDIRECT ESTIMATIONS

Credit: 3
(Lecture: 2, Tutorial:1)

Hour: 45

COURSE OUTCOMES:

- To acquaint students to understand demographic models.
- Indirect estimations and carry out population projections independently
- Apply them in other social sector projections.

COURSE CONTENT:

Concepts of Demographic Models:

Stable population; Generalized Population; Momentum of Population Growth; Concept of Multiregional Model; and Micro Model such as Birth Interval, Waiting Time (Birth Distribution etc, Estimation of fecundability?)

Model life tables; multistate life tables

Indirect methods for estimating fertility:

Needs for Indirect methods; Concept of Reverse Survival Method, Robust Method and method based on Generalized Population Model; Rele's Method; Concept of P/F ratio method and its modification [Hypothetical Cohort methods]

Indirect Method of Estimating Mortality:

Indirect Methods of Estimating Infant and Child Mortality

a) Basic concepts, fundamental assumptions and underlying principles to the technique proposed by Brass based on retrospective data on children ever-born and surviving mothers classified by current age of mother;
b) Modifications proposed by Sullivan and subsequently by Trussell over Brass method; and
c) the UN revised and extended version of Trussell's method.

Some Methods of Estimating Adult (including Maternal Mortality) and Old Age Mortality

a) Some methods of estimating adult mortality using successive census age-distributions;

b) Methods of estimating life expectancies at older ages; and

c) Estimation of maternal mortality through sisterhood method.

Some Indirect Methods for Estimating Death Registration Completeness for Countries Having Limited and Defective Vital Registration Data

An overview of some selected methods of estimating completeness of death registration, starting from Brass growth balance method and its subsequent development.

Lab Practice in MORTPAK

READING LIST:

Bennett, N. G., & Horiuchi, S. (1981). Estimating completeness of death registration in a closed population. *Population Index, 47*(2), 207-221.

Bennett, N. G., & Horiuchi, S. (1984). Mortality estimation from registered deaths in less developed countries. *Demography, 21*(2), 217-233.

Bhat, P. N. M. (2002). General growth balance method: A reformulation for population open to migration. *Population Studies, 56*, 23-34. https://doi.org/10.1080/003247202760341585

Bhat, P. N. M. (2002). Completeness of India's Sample Registration System: An assessment using the general growth balance method. *Population Studies, 56*, 119-134. https://doi.org/10.1080/003247202760341594

Coale, A. J. (1981). Robust estimation of fertility by the use of model stable population. *Asian and Pacific Census Forum, 8*(2). East-West Centre, Honolulu, Hawaii.

EL. Badry, M. A. (1961). Failure of enumerators to make entries of zero: Errors in recording childless cases in population censuses. *Journal of American Statistical Association, 56*.

Government of India. (2006). *Population projections for India and states, 2001-2026*. Office of the Registrar General.

Hill, K. (1987). Estimating census and death registration completeness. *Asia and Pacific Population Forum, 1*(3), 8-13, 23-24.

Horiuchi, S., & Coale, A. J. (1982). A simple equation for estimating the expectation of life at old ages. *Population Studies, 36*, 317-326. https://doi.org/10.1080/00324720308024

Jacob, S. S., & Swanson, D. A. (2004). *The methods and materials of demography* (2nd ed.). Elsevier Science.

John Weeks. (2005). *Population: An introduction to concepts and issues* (9th ed.). Wordsworth Learning.

Keyfitz, N. (1977). *Introduction to the mathematics of population with revision*. Addison-Wesley Publishing Company.

Kim, Y. J., Schoen, R., & Sarma, P. S. (1991). Momentum and the growth-free segment of population. *Demography, 28*(1), 159-173. https://doi.org/10.2307/2061511

Lahiri, S. (1990). Some new approaches to the estimation of life expectancies at older ages. In *Dynamics of population and family welfare* (Srinivasan & K. B. Pathak, Eds.), pp. 315-341.

Lahiri, S., & Menezes, L. (2004). Estimation of adult mortality from two enumerations of a destabilized population subject to response biases in age-reporting. In *Population, health and development in India: Changing perspectives* (T. K. Roy, M. Guruswamy, & P. Arokiasamy, Eds.), pp. 101-136. Rawat Publications.

Lahiri, S., Srinivasa Rao, A. S. R., & Srinivasan, S. (2005). Role of age-specific growth rates on population ageing in some developed and developing countries – A comparative study. *Demography-India, 34*(1), 63-83.

Martin, L. G. (1980). A modification for use in destabilized population Brass's technique for estimating completeness of death registration. *Population Studies, 3*(1), 39-51. https://doi.org/10.1080/00324720308024

Mishra, B. D. (1981). *Introduction to study of population*. South Asian Publishers.

Mitra, S. (1984). Estimating the expectation of life at old ages. *Population Studies, 38*, 313-319.

Pathak, K. B., & Ram, F. (1998). *Techniques of demographic analysis* (2nd ed.). Himalaya Publishing House.

Potter, R. G., & Kulkarni, P. M. (1977). Population momentum: A wider definition. *Population Studies, 40*, 555-556.

Preston, S. H., & Coale, A. J. (1982). Age structure, growth, attrition, and accession: A new synthesis. *Population Index, 48*(2), 217-259.

Preston, S. H., Himes, C., & Mitchell, Eggers. (1989). Demographic conditions responsible for population aging. *Demography, 26*(4), 691-704.

Preston, S. H., Heuveline, P., & Guillot, M. (2003). *Demography: Measuring and modeling population processes*. Blackwell Publishers.

Preston, S. H., & Lahiri, S. (1991). A short-cut method for estimating death registration completeness in destabilized populations. *Mathematical Population Studies, 3*(1), 39-51. https://doi.org/10.1080/08898489109525204

Rele, J. R. (1967). Fertility analysis through extension of stable population concepts. *Population Monograph Series No. 2*, University of Berkeley.

Rele, J. R. (1987). Fertility levels and trends in India, 1951-81. *Population and Development Review, 13*(2), 329-342.

Schoen, R., & Kim, Y. J. (1991). Momentum towards stability as a fundamental principle of population dynamics. *Demography, 28*(3), 455-466. https://doi.org/10.2307/2061513

Siegel, J. S., & Swanson, D. A. (2004). *The methods and materials of demography* (2nd ed.). Elsevier Academic Press.

Course Code: MSD E524

Course Title: HEALTH ECONOMICS AND FINANCING

Credit: 3 **Hour: 45**
(Lecture: 2, Tutorial:1)

COURSE OUTCOMES:

- To introduce various concepts on economic gradient of health and demand for and supply of health care.CO2: To explain various measures on socio-economic inequality in health.
- To familiarize the means and measures of health financing.
- To understand the determinants of health insurance and its coverage.
- To introduce the methods and measures on economic evaluation of health care.

COURSE CONTENT:

Introduction to Health Economics

Defining health economics, why health economics is important, basic concepts in microeconomics, health across world and over time, scope of health economics, map of health economics, basic questions confronted by health economist, concept of efficiency and equity in health, Production Possibility Frontier (PPF), economic gradient of health, causation of income and health, Preston Curve, economic models and analysis, expenditure function, Theories of X and Y, positive and normative economics.

The Demand for Health and Health care

What is Health and Good Heath, Utility Analysis, Health as a form of human capital, What is Medical Care, The production of Good Health, Empirical evidences in the production of health, Health as human capital, Grossman Model, The Demand for Health Care, Demand function for health, Economic and non- economic factors of health care, Fuzzy Demand Curve, Price and income elasticity of demand for health care, Important consideration in estimating health care demand elasticity, provider's behavior, Empirical findings, externalities and market failure.

Health Financing

Health financing in low, middle and high income countries, demographic transition,

epidemiological transition and health expenditure, disparity in disease burden and per-capita health spending, sources of health care in India, out-of-pocket expenditure on health care, catastrophic health expenditure, approaches in measuring catastrophic expenditure, impoverishment, health care payment and poverty, national and regional patterns of catastrophic health spending, determinants of catastrophic health spending, Drivers of health care expenditure, health financing in India, Equity in health care finances, Willingness to pay for health care, User charges as determinant of health financing, Performance based financing

Health Insurance

Health care system, a model of health care system, defining health insurance, need for health insurance, type of health insurance, demand for private health services, factors affecting the quantity demanded of health insurances, moral hazards, deductibles, co-insurance, managed care, adverse selection, loading fees, employed based insurance, reimbursement, selection effect, intermediary agent, regulation of health insurance, Need for Government intervention, Trends of health insurance, Coverage of health insurance in India, PM-JAY, coverage and effectiveness.

Measuring Health Inequalities

Measurement of health inequality: A Prelude: Why measure health inequality; Health equity and inequality: Concept and definitions; Understanding of the concepts such as need, access and utilisation; cardinal and ordinal health variables

Black Report and Beyond: Historical Background of Black Report, Explanation for social class differences, major empirical theme since Black report

Measures of health inequality: Measures of health inequality: Index based approach; Axiomatic approach to measurement; Individual- mean and inter-individual comparison; WHO Index, Coefficient of Variation, Generalised Entropy Index, Lorenz Curve and Gini Coefficient

Measuring socioeconomic rank related health inequality: Slope index of inequality; Relative index of inequality; Concentration curve and concentration index: various ways of computing; Standardization; Inequality aversion; Normalised and Generalised concentration index; Corrected concentration index

Measuring inequality in healthcare utilization: Horizontal inequality; Vertical inequality; Regression based approach; Measurement of horizontal inequalities; Group inequality, common measures, Gini type index

Medical Care, Production and Cost

The Short-Run Production Function of the Medical Firm, Total Product, Marginal Product and Average Product Curve, Law of diminishing marginal productivity, The importance of costing in Health Economics, Short-run cost theory of medical firm, short run cost curves, Cost analysis, Implicit and explicit cost, , factor affecting short-run cost curves, cost minimization, constraints in measuring health cost.

Economic Evaluation

What is economic evaluation? Cost analyses; direct cost, Indirect cost, tangible cost, capital cost, fixed cost, variable cost, Opportunity cost, average cost, marginal cost, Incremental cost, steps in cost analyses: Identification, measurement and valuation, Various types of economic evaluation used in health care: Cost effectiveness analysis (CEA) Cost-Benefit Analysis (CBA), Divergence between social and private costs and benefits in health care, Limitations of economic evaluation, Consumer Impact Assessment.

READING LIST:

Arrow, K. J. (1978). Uncertainty and the welfare economics of medical care. In *Uncertainty in economics* (pp. 345-375). Academic Press.

Culyer, A. J., & Newhouse, J. P. (Eds.). (2000). The state and scope of health economics. In *Handbook of health economics, Volume 1A*. Elsevier.

Drummond, M. F., Sculpher, M. J., Torrance, G. W., O'Brien, B., & Stoddart, G. L. (Eds.). (2005). *Methods for economic evaluation of health care programmes* (3rd ed.). Oxford University Press.

Fan, V. Y., & Savedoff, W. D. (2014). Health financing transition: A conceptual framework and empirical evidence. *Social Science & Medicine, 105*, 112-121. https://doi.org/10.1016/j.socscimed.2014.01.027

Glied, S., & Smith, P. C. (Eds.). (2012). *The Oxford Handbook of Health Economics* (online ed.). Oxford Academic. https://academic.oup.com/edited-volume/28339

Gottret, P. E., & Schieber, G. (2006). *Health financing revisited: A practitioner's guide*. World Bank Publications.

Grossman, M. (1982). On the concept of health capital and demand for health. *Journal of Political Economy, 80*(2), 223-255.

Macintyre, S. (1997). The Black Report and beyond—What are the issues? *Social Science & Medicine, 44*(6), 723-745. https://doi.org/10.1016/S0277-9536(96)00179-6

Pauly, M. V. (1968). The economics of moral hazard: Comment. *The American Economic Review, 58*(3), 531-537.

Phelps, C. E. (2017). *Health economics* (6th ed.). Routledge.

Snterre, R. E., & Neun, S. P. (2007). *Health economics: Theories, insights, and industry studies* (4th ed.). Thompson South-Western.

Wagstaff, A., O'Donnell, O., Van Doorslaer, E., & Lindelow, M. (2007). *Analyzing health equity using household survey data: A guide to techniques and their implementation*. World Bank Publications.

Wagstaff, A., Paci, P., & Van Doorslaer, E. (1991). On the measurement of inequalities in health. *Social Science & Medicine, 33*(5), 545-557. https://doi.org/10.1016/0277-9536(91)90105-7

Xu, K. (2005). Distribution of health payments and catastrophic expenditures. *World Health Organization*.

Course Code: MSD E525

Course Title: POPULATION, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

Credit: 3 **Hour: 45**
(Lecture: 2, Tutorial:1)

COURSE OUTCOMES:

- Learn the concept of sustainable development and its challenges.
- Learn quantitative and qualitative methods in environmental health analysis.
- Comprehend the role of the environment in development modeling.

COURSE CONTENT:

Sustainable development: Conceptual and contemporary issues

Sustainable development; Meaning, Concepts, and Definitions; Inter-linkages between ecology and development; Brundtland Report on Environment and Development; SDG goals, progress; Pillars of SDG; Environmental Kuznetz model, Living Planet Index, ecological footprint;

Approaches to environment; Gandhian, Socialist, Neo-classical approach; Environment and development challenges: Water, energy, health and disease, nutrition, education, energy, food, species, climate;

Trends of global warming and climate change; drivers of global warming and Global Warming Potential (GWP) & climate change; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses, CO2 fertilization and agriculture; impact on the economy and spread of human diseases; the challenges for International Environmental Governance.

Environmental challenges in India

Calamities and the measurements; urban challenges; environmental health hazards; air Pollution and health- estimate, data sources, Indian standards, geospatial modeling;

Water resources and condition of surface and ground water resources; water quality standards in India; role of state in water resources management, water and health;

Regional Development in India; Women and Environment; Green Movements in India; Solid Waste Management; Success models of efficient environmental management;

Environmental resilience, adaptive capacity, and vulnerability (RACV) Meaning and measurements of vulnerability and resilience, concept and processes of adaptive capacity; indicators and modeling; qualitative methods to measure RACV; Case studies and practical exercises.

READING LIST:

Bongaarts, J. (1992). Population growth and global warming. *Population and Development Review, 18*, 299-319.

Bründtland, G. H. (1987). *Our common future: The World Commission on Environment and Development*. Oxford University Press.

Hardin, G. (1968). The tragedy of the commons. *Science, 162*(3859), 1243-1248. Reprinted in R. R. Campbell & J. L. Wade (Eds.), *Society and environment: The coming collision* (pp. 1243-1248). Allyn and Bacon.

Hanley, N., Shogren, J. F., & White, B. (2007). *Environmental economics: In theory and practice*. Palgrave Macmillan.

Lutz, W., Prskawetz, A., & Sanderson, W. C. (Eds.). (2002). *Population and environment: Methods of analysis*. Supplement to *Population and Development Review*. Population Council.

Simon, J. L. (1996). *Population matters: People, resources, environment, and immigration*. Transaction Publishers.

Stern, N. (2014). *The economics of climate change: The Stern review*. Cambridge University Press.

UN Climate Reports. (n.d.). Retrieved from https://www.un.org/en/climatechange/reports

SEMESTER- IV

Code: MSD R501

Title: RESEARCH FIELDWORK

Credit: 6 **Hour: 90**

Guideline for Research Fieldwork

The paper is of 6 credits amounting to 90 hours. The division of the hours may be as follows:

Distribution of time

15 hours- Choosing a suitable topic, preparation and finalization of the study tools (qualitative guidelines and quantitative schedules/questionnaires) in consultation with the concerned teachers, Code of Conduct and ethical permission

5 hours- Preparation of data entry package (CS pro and other open access tools) and entry of quantitative data

35 hours- Field visit and collection of required data from community

5 hours- Preparation of qualitative transcripts

10 hours- Teaching Research Training/ oreintation of qualitative data analysis software- Atlas.ti, Anthropac and NVivo

10 hours- Preparation and presentation of the study findings

10 hours- Finalization and submission of the study/ research report (Individual as well as Group report)

Field work Instruments

The students are suggested to conduct **IDI, KII** besides **observation** and **social mapping** to gather qualitative data.

For gathering quantitative data, students may use **Interview schedule** or **Questionnaire.**

Software for Qualitative Research:

ANTHROPAC, Atlast Ti and Group Work

Software for Data Collection in large scale surveys

Computer assisted personal interview (CAPI), process of data transfers, introduction to features of Census and Survey Processing System (CSPro), steps for development of data entry software in CSPro; Web-designed questionnaires.

READING LIST:

CSPro Software. (n.d.). *CSPro software*. U.S. Census Bureau. Retrieved from www.census.gov/data/software/cspro.Download.htm

DHS Program. (n.d.). *DHS manuals*. Retrieved from https://dhsprogram.com/what-we-do/survey-operations/manuals.cfm

Longitudinal Ageing Study in India (LASI). (n.d.). *LASI manual for interviewer*.

National Family Health Survey (NFHS). (n.d.). *NFHS manual for interviewer*.

National Family Health Survey (NFHS). (n.d.). *Manual for CAPI used in NFHS*.

United Nations. (2005). *Household sample surveys in developing and transition countries*. United Nations Statistics Division. Retrieved from www.unstats.un.org/unsd/hhsurveys/

Code: MSD R511

Title: REVIEW PAPER

Credit: 3 **Hour: 45**

Systematic Review and Application of Meta-Analysis

COURSE OUTCOMES:

- Learn and describe the process and the uses of systematic reviews and meta-analyses.
- Learn skills required for performing basic systematic reviews and meta-analyses.
- Perform and submit research report by conducting an exercise of Systematic Review and Meta-Analysis on any given/select topic.

COURSE CONTENT:

Theory and application of Systematic Review and Meta-Analysis

This part is classroom teaching and discussion to be carried out by assigned teachers.

Introducing the systematic reviews: Need for a systematic review, difference between a narrative and a systematic review. Producers and users of systematic reviews, systematic review for randomized control trials and observational studies, and main challenges in systematic reviews.

Developing a protocol for a systematic review: Determining scope of a review, defining the research question, framing the question (PICO/PECO), deciding the type and scope of the question, defining specific inclusion and exclusion criteria, Introduction to the Cochrane Collaboration, examples of questions and inclusion/exclusion criteria from Cochrane.

Developing an analytic framework for review: Searching strategy, identifying key sources and techniques for searching, using databases for searching articles, building a high-quality search strategy, documenting search conclusions, reference management.

Meta-analysis: Why do a meta-analysis? Strengths and weaknesses compared to narrative literature reviews. General steps of a meta-analysis, Hypotheses and problems in research synthesis, Types of data and summary measures, Statistical methods for meta-analysis, effect sizes, standardized

mean difference, cumulative meta-analysis, fixed effect model, random effect model and summary effects.

Biases in the systematic review and meta-analysis: Selection bias, information bias and analysis bias. Heterogeneity, minimising meta-bias, meta regression, and handling within study dependency.

Reporting guidelines and tools: PRISMA, MOOSE, Screening i.e. Rayaan, EPPI-Reviewer, Covidence, DistillerSR. Qualitative synthesis, Interpreting results and their presentation.

Research Component

Distribution of time

10 hours- Choosing a suitable topic using PICO framework, selection of article searches databases and key words. Conducting article search, setting inclusion and exclusion criteria and preparation of PRISMA.

10 hours- Preparation of database for meta-analyses. Conversion of Odds ratios to Hazard ratio or Hazard to Odds ratios. Estimation of standard errors from confidence intervals.

10 hours– Meta Analysis: Fixed or Random effects, Heterogeneity Analyses: Funnel Charts; Risk Bias

10 hours- Writing Paper Using Cochran Template and Method Wizard

5 hours- Finalization and submission of the Article according to select journal including reference management.

READING LIST:

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2021). *Introduction to meta-analysis*. John Wiley & Sons.

Card, N. A. (2015). *Applied meta-analysis for social science research*. Guilford Publications.

Egger, M., Smith, G. D., & Altman, D. (Eds.). (2008). *Systematic reviews in health care: Meta-analysis in context*. John Wiley & Sons.

Higgins, J. P., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (Eds.). (2019). *Cochrane handbook for systematic reviews of interventions*. John Wiley & Sons. https://training.cochrane.org/handbook/current

Leandro, G. (2005). *Meta-analysis in medical research: The handbook for the understanding and practice of meta-analysis*. John Wiley & Sons.

Macaskill, P., Gatsonis, C., Deeks, J., Harbord, R., & Takwoingi, Y. (2010). *Cochrane handbook for systematic reviews of diagnostic test accuracy*. Cochrane Collaboration.

Code: MSD R521

Title: PROJECT ON DATA ANALYTICS

Credit: 3 **Hour: 45**

COURSE OUTCOMES:

- Students should be able to demonstrate a comprehensive understanding of data analytics techniques and tools while delivering impactful, data-driven insights to solve real-world problems.
- After completing the project, students will be able to gain the required technical and research skills for their future prospects in the research and Industry.

PROJECT GUIDELINES:

Recommended Areas:

- Demography, Health, and Social Sciences or an interdisciplinary area.

Each student may choose one topic from the given below suggested list-

1. Development of Monitoring & evaluation framework
2. Sampling Scheme implementation
3. Preparation of data collection tools
4. Replica of analysis of any Published article in peer reviewed journal
5. Generating factsheet or table using large-scale survey data.
6. Interactive Dashboard

Master of Science in Survey Research and Data Analytics

Course Code	Course Name	Course type	Credits	Hours	L	T	P	Weightage	
								Internal exam	Semester exam
SEMESTER-I									
IKS 401	Indian Knowledge System-1	IKS	2	30	2	0	0	40	60
MSD F401	Demographic Methods	F	3	45	2	1	0	40	60
MSD F402	Social Sciences Concepts	F	3	45	2	1	0	40	60
MSD C401	Mathematics for Data Analytics	C	2	30	2	0	0	40	60
MSD C402	Statistical Methods and Approaches	C	3	45	2	1	0	40	60
MSD C403	Acquainting with data: Surveys and Sources	C	2	30	2	0	0	40	60
MSD C404	Sample Survey Designs	C	2	30	2	0	0	40	60
MSD C405	Programming with R	C	2	45	1	0	1	60	40
MSD C406	Analytics in STATA	C	2	45	1	0	1	60	40
Semester Credits			**21**	**345**					
SEMESTER-II									
MSD C407	Data Visualization with Software	C	2	45	1	0	1	60	40
MSD C501	Principles and Methods of Data Collection	C	3	45	2	1	0	40	60
MSD C502	Advanced Sample Survey Designs	C	2	30	1	1	0	40	60
MSD C503	Data Quality Assessment and Management	C	3	45	2	1	0	40	60
MSD C504	Programming for Data Analytics in Python	C	2	45	1	0	1	60	40
MSD C505	Predictive Analytics: Theory and Practice	C	2	30	2	0	0	40	60
MSD E501	Introduction to Longitudinal Data Analysis	E	3	45	2	1	0	60	40
MSD E502	Spatial Analytics								
MSD E511	Health Systems, and Policies	E	3	45	2	1	0	40	60
MSD E512	Urbanization, Space and Planning								
MSD VI	Viva-voce	VI	2						
VAC 401	Value added course	VAC	NC	30					
MSD I	Internship on Survey Research and Data Analytics	I	NC						
Semester Credits			**22**	**360**					
Year 1 Credits			**43**	**705**					

SEMESTER-III									
IKS 501	Indian Knowledge System-2	IKS	2	30	2	0	0	40	60
MSD C506	Ethics in Research and Publications	C	2	30	2	0	0	40	60
MSD C507	Artificial Intelligence and Machine Learning Applications	C	3	45	2	1	0	50	50
MSD C508	Applied Multivariate Analysis	C	2	30	2	0	0	40	60
MSD C509	Program Monitoring and Evaluation Design	C	3	45	2	1	0	40	60
MSD C510	Analysis of Complex Survey and Estimation	C	2	30	1	1	0	40	60
MSD C511	Projections and Forecasting	C	3	45	2	1	0	40	60
MSD E521	Bayesian and Small area estimation Methods	E	3	45	2	1	0	40	60
MSD E522	Concepts and Measures of Global Health								
MSD E523	Demographic Models and Indirect Estimations								
MSD E524	Health Economics and Financing								
MSD E525	Population, Environment and Sustainable Development								
Semester Credits			**20**	**300**					
SEMESTER-IV									
MSD R501	Research Field work	R	6	90					
MSD R511	Review paper	R	3	45					
MSD R521	Project on Data Analytics	R	3	45					
MSD R531	Dissertation	R	8	120					
MSD V2	Viva-voce	V2	2						
Semester Credits			**22**	**300**					
Year 2 Credits			**42**	**600**					
TOTAL CREDITS (including 4 credits of viva-voce)			**85**	**1305**					

Notes:

- IKS-Indian Knowledge System course, F-Foundation course, C- Core course, E-Elective course, R- Research, VAC-Value Added Course, V-Viva voce, D- Dissertation, L-Lecture, T-Tutorial and P-Practical.
- NC: Non-Credited courses are not counted for calculating the final grade.
- Core course: Must for all the students and cannot be changed.

- Elective course: One elective course should be opted from a pair.
- Semester II: One elective should be opted from each group i.e. E501/502; E511/E512
- Semester III: One elective should be opted from each group; i.e. E521/E522/E523/E524/E525

Notes:

Internal Examination

Faculty members are given the flexibility to decide mode of internal examination from the following list: Written Test; Open Book Test; Written Home Assignment; Individual Thematic Presentation; Thematic Group Presentation; Group Discussion; Surprise Test; MCQ Test; Case Study; Situation Analysis (group activity or individual activity); Field Visit; Small Group Project & Internal Viva-Voce; Role Play / Story Telling; Literature Review / Book Review; Model Development/ Simulation Exercises (Group Activity or Individual Activity); In-depth Viva; Quiz; etc.

Evaluation criteria of Research Fieldwork (MSD R501)

As the course is of 6 credits, the evaluation must be done considering several aspects, including,

- Quality of the tools
- Robust methodology to conduct the study
- Presentation and defense
- Individual report
- Group report

The teachers should evaluate the students' performance based on the followings criteria:

Content	Weightage %	Marks obtained
Relevance of the topic	10	
Quality of the tools	20	
Methodology to conduct the study	20	
Presentation and defence	20	
Individual report	20	
Group report	10	
Total Marks	**100**	

Note: Total obtained marks should be converted to final grades as per the Institute's guideline

Evaluation criteria of Review Paper (MSD R511)

The teachers should evaluate the students' performance based on the followings criteria:

Content	Weightage %	Marks obtained

PICO Framework	10	
PRISMA	10	
Meta Analyses	20	
Risk Bias analyses	10	
Method Wizard	20	
Final Write-up	30	
Total Marks	**100**	

Note: Total obtained marks should be converted to final grades as per the Institute's guideline.

Evaluation criteria of Project on Data Analytics/ Project on Data Presentation (MSD A521)

Project submission and evaluation criterion:

Evaluation: Students will submit their concept note of their project within one week of the commenced of this project.

S. No.	Topic	Submission
1	Development of Monitoring & evaluation framework	Title, objective of the project, Programme/policy Goal, objectives, Outcome, Output, Process, Input level indicators, with means of verification/source
2	Sampling Scheme implementation	A report including title, objective, Sampling scheme sample size estimation, selection methods, illustration of sampling method adopted, may use any software such as excel, R, STATA and submit their original supporting files with the report
3	Preparation of data collection tools	Title, Research objective, Questionnaire, manual for data quality assurance, Computer Assisted Personal Interview (CAPI), other digital tools
4	Review and Replica of analysis of any Published article in peer-reviewed journal	Summary of the review of the article, syntax/program code files with all associated files.
5	Generating factsheet or table from published factsheet/report of any large-scale survey	Title, objective Methodology including Definition of indicators, respondents, syntax/program code files with all associated files.

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6	Interactive Dashboard	Title, Objective, research/project questions, data cleaning steps, Storyline, key messages for policy decision
7	AI/ automate tool related to health and social science	Project Title, Objective, User manual, Application

Their presentation of the project will be evaluated by the evaluation committee of three members.

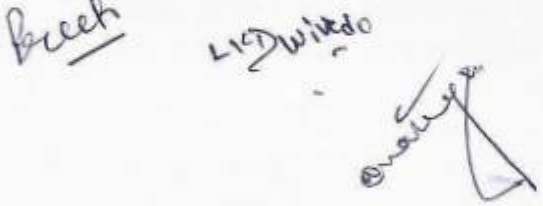
Particular	Percentage
Presentation	30%
Report/ tools/ syntax	70%

Dissertation: Weightage for evaluation of dissertation: Guide 0.25, Presentation & Defense 0.25; and Content 0.50.

Evaluation of Dissertation: The Director & Senior Professor appoints an evaluation committee for dissertation consisting of three members from among the faculty of TIPS. First, the committee members independently assess the 'oral presentation and defense of the student and submit their grade to the Controller of Examinations. Second, the committee members independently evaluate the content of the 'final dissertation' submitted by the student and submit their grades to the Controller of Examinations. To arrive the final dissertation grade, the average of overall all grades of Guide, Presentation & Defense, and Content is considered.

Best Dissertation Award: The Director & Senior Professor appoints a committee consisting of three external experts for recommending the award of the best dissertation. The dissertations of top five ranks (based on the combined score of content, presentation and defense) are placed before the committee. The external members evaluate dissertations and submit their recommendation in a sealed cover to the Controller of Examinations.

Viva voce; Director & Senior Professor constitutes a committee comprising of one external examiner and three/four internal examiners for the viva-voce. The three/four internal examiners shall comprise of one senior professor (Chairperson), one/two faculty members and one programme coordinator. The committee members independently evaluate the performance of the students in the viva-voce and assign their grades. To arrive the final viva-voce grade, the average of the evaluation of the members is considered.



Grades Table

GRADE TABLE FOR EVALUATION OF ANSWER SHEET

Final Grade	Grade Point	Grade Description
O Only	10	Outstanding
A Plus	9	Excellent
A Only	8	Very Good
B Plus	7	Good
B Only	6	Above average
C Only	5	Average
P Only	4	Pass
F3	3	Fail
F2	2	Fail
F1	1	Fail
NA/AB	0	Not Attempted / Absent

GRADE TABLE FOR SEMESTER GRADE CARD

The Grades, Grade Point and Descriptions are as given below

Final Grade	Grade Point	Grade Description
O Only	10	Outstanding
A Plus	9	Excellent
A Only	8	Very Good
B Plus	7	Good
B Only	6	Above average
C Only	5	Average
P Only	4	Pass
F Only	0	Fail
NA/AB	0	Not Attempted / Absent