Course Title: Quantitative Methods in Social Science Research

Course Code: IS602P

Course Level: PhD level

Credits: 4

Course Type: Optional

Instructors: Prof. Mandira Sarma, Dr. Rashmi Barua

Course Description:

Quantitative analysis plays a fundamental role in evidence-based planning and decision making across various sectors including government, private sector, and international organizations. Studies and research in International Relation (IR), Area Studies, Political Science and other areas of Social Science can be made more impactful if augmented with empirical analysis. Abundance of socio-economic-political data and availability of statistical software make it quite attractive for researchers in IR, political science and other areas of social science to conduct empirical research utilizing real world data. However, sound understanding of statistical theory and quantitative methods is essential for correct and appropriate interpretation of empirical results. This PhD level course will expose social science students (with school level Maths) at SIS to statistical and quantitative methods and tools in order to enable them to augment political science and international studies research with empirical analysis.

Course Objectives:

- To expose social science scholars to fundamentals of statistical methods
- To equip social and political scientists with empirical skills and econometric tools

Learning Outcomes: Upon completion of this course, social/political science students will be able to

- Acquire applied statistical skills and econometric tools to conduct empirical studies in their area of research.
- Read, understand and review applied quantitative articles in IR studies, Political Science and other areas of social science.

Evaluation: Mid-term and end term examinations, graded assignments and project work.

Module 0: Preliminary Concepts (Recap) [Approximately 3-4 lecture hours]

Variables; Functions; 2-dimensional (2-D) co-ordinate system and graphical representation of various functions (linear, exponential, logarithmic etc); Plotting lines on a graph, slope and intercept, algebraic equation of a line; Difference between data and variable; discussion on descriptive statistics and inferential statistics

Reading material: Specially designed reading material/handouts will be provided in class, based on students' requirement(s).

Module 1: Descriptive Statistics [Approx. 6/7 lecture hrs]

Presentation of data – tabulation and plotting; Describing the centre of the data –various measures of central tendency – mean (simple and weighted; arithmetic and geometric with example of UNDP Human Development Index), median and mode; Measures of positions – quartiles, deciles and percentiles; Describing the variability of the data - definition, interpretation, properties and application of various measures of dispersion - range, interquartile range, variance and standard deviation; The z-score; Measures of symmetry/skewness and kurtosis; Bivariate descriptive statistics – Correlation analysis

Readings: Agresti and Finlay (Chapter 3); Ross (Chapters 2 and 3); Freedman et al. (Chapters 3,4,5)

Module 2: Fundamentals of Probability Theory [Approx. 6/7 lecture hrs]

Random variables and probability functions - discrete and continuous; Some Common discrete probability functions – Bernoulli, Binomial, Poisson etc.; The Normal (Gaussian) probability distribution and other useful distributions based on the Normal distribution – t, F and chi-square distributions; The Law of Large Numbers and Central Limit Theorem – statements and applications only

Readings: Agresti and Finlay (Chapter 4); Ross (Chapters 4,5 and 6); Freedman et al. (Chapters 13)

Module 3: Statistical Inference (Estimation and Testing) [Approx. 5/6 lecture hrs]

Concepts of a statistics via-a-vis a parameter; sampling distribution; unbiased and efficient estimators; estimation of mean and variance of a population; Formulating statistical hypotheses, null and alternative hypotheses, significance level, type I and type II errors, testing of hypotheses relating to mean and variance.

Readings: Agresti and Finlay (Chapters 5 and 6); Ross (Chapters 8, 9, 10, 11); Freedman et al. (Chapter 26)

Module 4: Linear and Multiple Regression analysis and estimation [Approx. 7/8 lecture hrs]

Causal relationships, types of data, dummy variables, least square regression, correlation coefficient, coefficient of determination, regression and correlation, multiple regression analysis, interaction variables, estimating regression coefficients, regression analysis using statistical software.

Readings: Schroeder, L., Sjoquist, D., & Stephan, P. (2017). *Understanding regression analysis*. Chapter 1, chapter 2 and chapter 4

Module 5: Problems and Issues in Linear Regression Analysis (Approx 6/7 hours)

Specification, measurement error, selection bias, reverse causality, omitted variable bias, multicollinearity, empirical application of these issues using statistical software.

Readings: Schroeder, L., Sjoquist, D., & Stephan, P. (2017). *Understanding regression analysis*. Chapter 5

Module 6: Impact Evaluation and Causal Inference (Approx 6/7 hours)

Potential outcomes and counterfactuals, average treatment effects, randomization in social policy, intention to treat effects, treatment on the treated effects, practical problems with randomization, natural experiments, Differences-in-differences.

List of Readings:

Alan Agresty and Barbara Finlay (2009), *Statistical Methods for the Social Sciences*, Fourth Edition, Pearson Prentice Hall

David Freedman, Robert Pisani and Roger Purves (2009) *Statistics*, Fourth Edition, Viva-Norton Student Edition

Sheldon M. Ross (2017) *Introductory Statistics*. Elsevier Inc

Schroeder, L., Sjoquist, D., & Stephan, P. (2017). *Understanding regression analysis*. SAGE Publications, Inc

Additional Resources:

Teorell, Jan, Aksel Sundström, Sören Holmberg, Bo Rothstein, Natalia Alvarado Pachon, Cem Mert Dalli, Rafael Lopez Valverde & Paula Nilsson. 2024. *The Quality of Government Standard Dataset*. https://www.gu.se/en/quality-government doi:10.18157/qogstdjan24

The Human Development Index, https://hdr.undp.org/data-center/human-development-index#/indicies/HDI

Optional Readings:

Axel Dreher and Martin Gassebner (2012), "Do IMF and World Bank Programs Induce Government Crises? An Empirical Analysis", *International Organization*, Spring 2012, Vol. 66, No. 2 (Spring 2012), pp. 329-358

James D. Fearon and David D. Laitin (2003), "Ethnicity, Insurgency, and Civil War", *The American Political Science Review*, Feb., 2003, Vol. 97, No. 1 (Feb., 2003), pp. 75-90

Christopher Gandrud and Mark Hallerberg (2015), "When all is said and done: updating "Elections, special interests, and financial crisis"", *Research and Politics*, July-September 015: 1–9

Abhijit Banerjee and Esther Duflo, "Poor Economics: a radical rethinking of the way to fight global poverty" (Published by Public Affairs, New York , 2011)

Raymond Fisman & Edward Miguel, 2010. "Economic Gangsters: Corruption, Violence, and the Poverty of Nations," Economics Books, Princeton University Press, edition 1, number 9170.