Applied Statistics for Public Health Professionals

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Course Description

What are the socio-economic determinants of infant and maternal mortality in rural Pakistan? Does Conditional Cash Transfer Improve Health Outcomes? How does access to clean drinking water affect health outcomes in urban versus rural populations in Pakistan? What is the impact of lifestyle on non-communicable diseases such as diabetes and heart disease. How can we quantify the impact of climate change on public health outcomes? How to improve the improvement of mental health services, particularly for children and adolescents?

Public health scientists often address the above and many other questions by using statistical methods that are informed by theories in social and health sciences. Statistics allows us to draw conclusions from a set of data and is often called *'Science of Data'*. It can also help people in all industries answer their research or business questions and can help predict outcomes.

In this course, we provide an introduction to the tools used in basic quantitative social science applied in public health research. The first part of the course covers the basic use of statistics in public health research, while the remainder of the course focuses on causal inferences and the use of linear regressions in empirical research. Furthermore, the principles learned in this course provide a foundation for the future study of more advanced topics in quantitative methodology-something that is essential for prospective research students. We will cover both the theoretical and computational aspects of statistics, understand important theorems, and learn to analyze real data. Although statistical inference tools are worth studying in their own right, another goal of this course is to provide research students with the necessary skills to critically read, interpret, and replicate the quantitative content of many articles in public health journals. Our understanding will be supported through the use of statistical software called STATA during our practical exercises.

About the Instructor

Dr. Inayat Ullah is an applied researcher and academic specializing in impact evaluation, causal inference, and quantitative methods for public policy and public health. He currently serves as an Assistant Professor at the Jinnah School of Public Policy and Leadership at the National University of Sciences and Technology (NUST), Islamabad. Dr. Inayat's research portfolio spans diverse areas, including randomized controlled trials, quasi-experimental studies, difference-in-differences, instrumental variables, regression discontinuity, and geospatial data applications. He has directed large-scale evaluation projects in partnership with organizations such as the Asian Development Bank, UN agencies, GIZ, and Oxford Policy Management. His work includes evaluating the impact of air pollution on child mortality, evaluations of agricultural training programs, social protection systems, reforestation initiatives, education technologies, and climate resilience interventions. In 2023, his paper on impact evaluation of technology-based interventions and learning outcomes using ASER-Pakistan data was selected as the **winner of Innovative Policy Research Award** (Prize worth 2.1 million PKR) by the Asian Development Bank (ADB) and International Economic Association (IEA). He has published in leading international journals such as Land Use Policy and the International Journal of Environmental

Research and Public Health, and contributed to flagship UN reports, including the UNDRR Global Assessment Report 2025. His research has been presented at prestigious international forums such as the Asian Development Bank Annual Meetings, the Society for Research on Educational Effectiveness (SREE)-USA, and conferences in Washington D.C., Tokyo and Seoul.

Alongside his research, Dr. Inayat has substantial teaching experience at NUST and abroad, offering courses in applied econometrics, quantitative techniques, impact evaluation methods, and public financial management. He is proficient in advanced statistical software including STATA, R, and Python, and regularly integrates these tools into applied research and teaching. Dr. Inayat holds a Post-doc from Seoul National University (SNU), and PhD in Public Policy from the Korea Development Institute (KDI) School of Public Policy and Management, South Korea.

Prerequisites

The most important prerequisite is the willingness to work hard on possibly unfamiliar material. Quantitative methods and applied statistics are like a language, and it will take time and dedication to master its vocabulary. This presents a challenge for us as instructors to give you the best intuition and a challenge for you as a student to work hard to internalize that intuition.

Objectives

- To familiarize students with the basic concepts in statistics applied to real-life problems solving in public health policies and management.
- To introduce students to the use of statistical techniques in applied public health research.
- To develop quantitative skills in students to prepare them for future evidence-based health policy research.

Course Material

Since this course is designed to blend multiple areas of statistics, econometrics, and public health policy, therefore, the material distributed among you will come from a variety of sources. Relevant material for each section and topic will be distributed and students will be asked to read them well before each class. Besides those materials, the following books and web sources are recommended for general understanding:

Main Text:

Text 1: *Applied Statistics for Public and Non-Profit Administration* 9^{th} Edition by Kenneth J. Meier, Jeffrey L. Brudney and John Bohte, (2014), Cengage Learning USA.
Text 2: *The Effect: An Introduction to Research Design and Causality* by Nick Huntington Klein
Text 3: *Research Methods: The Essential Knowledge base* by William Trochim, (2015),

Tentative Evaluation Criteria:

Final Exam	40-45
Mid Term	20-25
Applied Research Project	15-20
Quiz/Class Participation	10-15

Course Outline

Course Content (Weekly)

Week	Lecture Topic	Reading
1	• Introduction to the Course • Some basic Concepts in quantitative methods and applied statistics	TBA
2	• Types of data, measurement scales, graphical summaries – Theory of Measurement – Measurement Validity – Measurement Reliability – **Application in MS Excel**	TBA
3	• Hypothesis Testing & P-values – Sampling distributions, central limit theorem, t-test, F-test, chi-square • **STATA-Lab: Application in STATA**	TBA
4	• Basics of Regression (OLS) – Simple & multiple linear regression, – interpretation of coefficients, – assumptions, diagnostics • **STATA-Lab: Regress, predict, residual analysis**	TBA
5	• Inferential Statistics – Estimating a Population Mean – Estimating a Population Standard Deviation – The Standard Error – How Sample Size Affects the Standard Error	TBA

Week	Lecture Topic	Reading
6	• Testing the Difference between Two Groups – Starting Research and Null Hypotheses for Difference of Means Tests – Understanding the Three Major Difference of Means Tests • **STATA-Lab: Application in STATA**	TBA
7	• Logistic Regression & Odds Ratio – Binary outcomes, – odds ratios, – logit interpretation, – goodness-of-fit. • **STATA-Lab: Applications in Excel and STATA**	TBA
8	• Fixed Effects & Random Effects Models – Panel data, – unobserved heterogeneity, – FE vs RE, Hausman test. • **STATA-Lab: Applications in Excel and STATA**	TBA
9	• Causal Inference Basics – Counterfactual framework, – potential outcomes, – selection bias, – randomization • **STATA Lab: Simulating an RCT, random assignment, balance tests.**	TBA

Week	Lecture Topic	Reading
10	• Randomized Controlled Trials (RCTs) – RCT design, – intention-to-treat (ITT), – treatment-on-treated (TOT), – compliance. • **STATA Lab: Simulating an RCT, random assignment, balance tests.**	TBA
11	• Quasi-Experiments: Difference-in-Differences – DID framework, – parallel trends assumption, – two-way FE models • **STATA Lab: Simulating an RCT, random assignment, balance tests.**	TBA
12	• Instrumental Variables (IV) – Endogeneity, – 2SLS, weak instruments, – IV assumptions. • **STATA Lab: ivregress 2sls, estat firststage.** • Regression Discontinuity Design (RDD) – Sharp vs fuzzy RD, – bandwidth choice, – graphical intuition • **STATA Lab: rdrobust, rdplot.**	TBA