

Statistical Methods for Economics

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Basic Knowledge I – References to statistical inference

Random Variables, Distribution Functions, Density Functions, Expected Values, Moments, Conditional Distributions and Independence, Covariance and Correlation, Basic Concepts of Random Samples, Sampling from the Normal Distribution, Methods of finding Estimator, Methods of Evaluating Estimator, Hypothesis Testing.

Basic Knowledge II – Review on linear regression

Classical Linear Regression: Descriptive Linear Regression, Classical Linear Regression Model, Statistical Inference in Classical Linear Regression.

Basic Knowledge III - Extensions of linear regression

Functional forms, Analysis of variance, Nonspherical disturbances: heteroskedasticity and autocorrelation, Multicollinearity, Variables selection, Stability of the regression function, Use of auxiliary information, Instrumental variables estimators.

Course Programme

Simultaneous Equation Models

The Model, Assumptions on error components and parameters' estimation (SEM).

Seemingly Unrelated (SUR): The Model, Estimation problems and Empirical Generalized Least Squares (EGLS).

Excursus on conditions for OLS consistency, Structural and Reduced Form equations, Identification and structural parameters, Rank and order conditions for structural parameters identification.

Consequences of order conditions, Exact identification: Indirect Least Squares Estimators (ILS), Over identification: Limited and Full Information methods, Two Stage Least Squares estimator (2SLS), Consistency of 2SLS, Three Stage Least Squares (3SLS).

Time Series Analysis

First-Order Difference Equations, p th-Order Difference Equations, Lag Operators, Stationary ARMA Processes, Forecasting, Maximum Likelihood Estimation, Spectral Analysis, Vector Autoregression, Introduction to multiple time series analysis, VAR model, VECM model.

Principal Component Analysis

Mathematical and Statistical Properties of Population Principal Components, Principal Components as a Small Number of Interpretable Variables, Choosing the number of principal components, Justification of the principal component MLE, Multidimensional scaling.

Cluster Analysis

An introduction to classification and clustering, measurement of proximity, hierarchical and non hierarchical clustering, optimization clustering techniques, model-based cluster analysis for structured data.

Big Data in Economics

Model's Validity and Causal Inference: Internal and external validity, Big data new frontiers for economic analysis.

Machine Learning and Causal Inference.

Structural Models, Experiments and Machine Learning: Developing, estimating and using structural models, Comparing experiments, structural models and machine learning methods for causal inference.

Books

Statistical Inference, G. Casella, R. L. Berger, 2nd Edition, Duxbury Advanced Series
Matrix Differential Calculus with applications in statistics and econometrics, J. R. Magnus, H. Neudecker, Wiley Series in Probability and Statistics
Econometric Analysis, W. H. Greene, 5th Edition, Prentice Hall
Time Series Analysis, J. D. Hamilton, Ed. Princeton
New Introduction to Multiple Time Series Analysis, H. Lutkepohl, Springer
Principal Component Analysis, Jolliffe I. T., Springer Series in Statistics
Cluster Analysis, 5th Edition, Everit B. S., Landau S., Leese M., Stahl D., Wiley Series in Probability and Statistics

Applied Statistics for Economics

Course Programme

Introduction to the statistical software R – Basic commands, Data Structures, Importing datasets.
Econometrics with R – multiple regression model, OLS and ML estimators, model selection and use of dichotomous variables, test on autocorrelation, heteroschedasticity, structural breaks, multicollinearity, presence of outliers, endogeneity. FGLS and IV estimators, dynamic linear models. SEM linear equation systems, EGLS estimators, 2SLS, 3SLS.

Time series analysis.

Principal component analysis.

Cluster analysis.

Application to real data drawn from Istat, Eurostat, and AMECO data sets.

Empirical applications using Big Data (Google Trends functions, query selection, aggregation and correlation problems, data quality).

Books

Introductory Statistics with R, Peter Dalgaard, Springer, 2008.

Applied Econometrics with R, Christian Kleiber and Achim Zeileis, Springer, 2008