FURTHER STATISTICS FOR ECONOMICS AND ECONOMETRICS (ME117)

Course duration: 54 hours lecture and class time (Over three weeks)

Summer School Programme Area: Research Methods, Data Science, and Mathematics

LSE Teaching Department: Department of Statistics

Lead Faculty: Dr James Abdey (Dept. of Statistics)

Pre-requisites: No previous knowledge of statistics will be assumed, although familiarity with elementary statistics to the level of ME116 would be an advantage (for example, descriptive statistics – sample mean and variance). Mathematics to A-level standard or equivalent is highly desirable, i.e. competency with basic calculus, integration and algebraic manipulation (although a refresher document will be provided).

Course Structure:

Course content will be delivered by formal lectures supported by daily classes. All topics will be explained during lectures accompanied by examples demonstrating the material. A comprehensive course pack will be provided and daily exercise sets will be distributed to provide an opportunity to practice problems. Solutions to exercises will be discussed and distributed in the classes. Supplementary materials will be accessible via the course's virtual learning environment to facilitate additional self-study.

Course Objectives:

The course provides a precise and accurate treatment of probability, distribution theory and statistical inference. As such, there will be a strong emphasis on mathematical statistics as important discrete and continuous probability distributions are covered. Properties of these distributions will be investigated followed by a thorough overview of parameter estimation techniques.

Application of this theory to the construction and performance of statistical tests follows, leading to multiple linear regression which is widely used in much economic and statistical modelling.

In summary, the main objectives of this course are:

1. To provide a solid understanding of distribution theory which can be drawn upon when developing appropriate statistical tests. Useful properties of some important distributions will be reviewed as well as parameter estimation techniques for various probability distributions.
2. To facilitate a comprehensive understanding of the main branches of statistical inference, and to develop the ability to formulate the hypothesis of interest, derive the necessary tools to test this hypothesis and interpret the results.

3. To introduce the fundamental concepts of statistical modelling, with an emphasis on linear regression models with multiple explanatory variables.

Collectively, these topics provide a solid training in statistical analysis. As such, this course would be of value to those intending to pursue further study in statistics, econometrics and/or empirical economics. Indeed, the quantitative skills developed by the course are readily applicable to all fields involving real data analysis.

Assessments:

Formative assessment: One assessed set of homework exercises

Mid-session examination: A mid-session exam (worth 30% of the overall grade) will take place on Tuesday of week two. Results will be released by Monday of week three. The precise time and location of the exam will be circulated during the programme.

Final examination: A final exam (worth 70% of the overall grade) will take place on Friday of week three. Results will be released within two weeks of the exam. The precise time and location of the exam will be circulated during the programme.

Reading List:

As a stand-alone course pack will be provided, there will be no need to rely on a particular text. Several good texts exist at the right level for this course which can be used in support of the provided course materials. A suggested text is:

- Larsen, R.J. and M.J. Marx (2011) *An Introduction to Mathematical Statistics and Its Applications*, Pearson Education, 5th edition.

Course Content:

Probability theory:	Set theory: the basics
	Axiomatic definition of probability
	Classical probability and counting rules
	Conditional probability and Bayes' theorem
Random variables:	Discrete random variables
	Continuous random variables

Common distributions:	Common discrete distributions
	Common continuous distributions
	Moment generating function
Multivariate random variables:	Joint probability functions
	Conditional distributions
	Covariance and correlation
	Independent random variables
	Sums and products of random variables
Sampling distributions of statistics:	Random samples
	Statistics and their sampling distributions
	Sampling distribution of a statistic
	Sample mean from a normal population
	The central limit theorem
	Some common sampling distributions
Point estimation:	Estimation criteria: bias, variance and mean squared error
	Method of moments (MM) estimation
	Least squares (LS) estimation
	Maximum likelihood (ML) estimation
Interval estimation:	Interval estimation for means of normal distributions
	Use of the chi-squared distribution
	Interval estimation for variances of normal distributions
Hypothesis testing:	Introductory examples
	Setting *p*-value, significance level, test statistic
	t tests

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	General approach to statistical tests
	Two types of error
	Tests for variances of normal distributions
	Summary: tests for μ and σ^2 in $N(\mu, \sigma^2)$
	Comparing two normal means with paired observations
	Comparing two normal means
	Tests for correlation coefficients
	Tests for the ratio of two normal variances
	Summary: tests for two normal distributions
Analysis of variance (ANOVA):	Testing for equality of three population means
	One-way analysis of variance
	From one-way to two-way ANOVA
Linear regression:	Introductory examples
	Simple linear regression
	Inference for parameters in normal regression models
	Regression ANOVA
	Confidence intervals for E(y)
	Prediction intervals for y
	Multiple linear regression models
	Multiple regression using Minitab
Nonparametric tests:	Tests for binary distributions
	Tests for medians
	Sign test
	Wilcoxon signed-rank test
Goodness-of-fit/independence tests:	Goodness-of-fit test for a finite distribution

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Tests for independence of two discrete random variables

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Credit Transfer: If you are hoping to earn credit by taking this course, please ensure that you confirm it is eligible for credit transfer well in advance of the start date. Please discuss this directly with your home institution or Study Abroad Advisor.

As a guide, our LSE Summer School courses are typically eligible for three or four credits within the US system and 7.5ECTS in Europe. Different institutions and countries can, and will, vary. You will receive a digital transcript and a printed certificate following your successful completion of the course in order to make arrangements for transfer of credit.

If you have any queries, please direct them to summer.school@lse.ac.uk