Statistical Theory for Social Scientists

1.0 course unit, Lecturer : D.S.G. Pollock

This is a whole-unit course taught over two semesters in one lecture and one problem class per week.

The aim is to provide a background in statistical theory for social scientists. The mathematics of the course reaches, but does not exceed, an A-level standard. It is envisaged that both students with A-level mathematics and students without will participate in the course which may be taken in any of the three years of a degree course.

The topics treated include the following:

Foundation of Probability

Empirical Frequency Distribution and their Moments
Set Theory and Boolean Algebra
Axiomatic Probability
Bayes' Theorem

Univariate Probability Distributions

Random Variables and Probability Distributions
Discrete Distributions: Geometric, Binomial, Poisson
Continuous Distributions: Uniform, Exponential, Normal
Distributions of a Function of a Random Variable:
    the Change of Variable Technique
Moments of Probability Distributions
Moment Generating Functions

Multivariate Distributions

Random Vectors and Multivariate Distributions
Marginal and Conditional Distributions
Moments of Multivariate Distributions: Variance–Covariance Matrices
Correlation and Regression
Empirical Regressions: Ordinary Least-Squares Estimates

Sampling Distributions

The Law of Large Numbers and the Central Limit Theorem
The Distribution of Sample Statistics:
    The chi-square, the t and the F distributions

Estimation

The Theory of Point Estimation:
Consistency, Efficiency and Mean-Square Error
Principles of Estimation:
the Method of Moments, the Method of Maximum Likelihood, Least-Squares Estimation

Interval Estimation and Hypothesis Testing

Confidence Intervals for Means and Variances
Statistical Decision Theory: Expected Loss,Type I and Type II Errors
Tests on the Mean and the Variance of a Normal Population

Books

There are a great number of books at all levels in statistical theory. Six books on differing levels which are appropriate to the course are

WONNACOTT, R.J. and WONNACOTT, T. H., *Introductory Statistics for Business and Economics,* John Wiley,

HEY, J.D., *Statistics in Economics,* Martin Robertson,

HOEL, P.G., *Introduction to Mathematical Statistics,* J. Wiley,

FREUND, J.E., *Modern Elementary Statistics,* Prentice Hall,

FREUND, J.E., and R.E. WALPOLE, *Mathematical Statistics,* Prentice Hall,

MENDENHALL, W., R.L. SCHEAFFER and D. D. WACKERLY, *Mathematical Statistics with Applications, second edition,* Dexbury Press.

Of these, WONNACOTT and WONNACOTT is probably the most elementary and may be read rapidly in order to get a superficial grasp of the subject. The other books will be referenced, when appropriate, at the various stages in the course. Students are advised to purchase a book which is on the same level as FREUND and WALPOLE or MENDENHALL et al. Further advice on the matter can be sought from the lecturer.