LTCC Basic Course

Title: Theory of Linear Models

Basic Details:

- Core Audience (1st yr or 2nd/3rd yr: pure, app. or stats): 1st year, statistics
- Course Format (extended or intensive): extended

Course Description:

- Keywords: Analysis of variance; estimation; generalized linear models; inference; nonlinear models; regression; neural networks.

- Syllabus: This course describes the theory behind the common methods of estimation and inference in linear models and extensions to related classes of models. After defining the general linear model and giving justifications for its use, we will consider least squares estimation, with a focus on estimable functions of parameters and properties of estimators. Other methods of estimation which aim for robustness or sparsity will be briefly described and compared with least squares and Bayesian linear models will be considered more extensively. The theory behind standard methods of inference in linear models will be described and small-sample alternatives will be discussed. Model selection and shrinkage and inference after model selection will be discussed. Finally, we will consider how and when the theory of linear models extends to other model types, such as transformed models, linear mixed models, generalized linear models, semiparametric regression models, machine learning models and nonlinear models.

- Recommended reading: C.R. Rao, H. Toutenburg, Shalabh and C. Heumann (2007) *Linear Models and Generalizations*, 3rd edition. Springer.

- Additional Optional reading: C.R. Rao (1973) *Linear Statistical Inference*, 2nd edition. Wiley.

- Prerequisites: Fundamental Theory of Statistical Inference (LTCC Basic course); good knowledge of matrix algebra and basic linear algebra; previous course on linear models would be an advantage, but not essential.

Format:

- No of discussion/problem sheets (typically 4 for extended courses, and 1 for intensive courses, with solutions): 4
- Electronic lecture notes: Yes, provided week by week.
- Necessary support facilities: Plenty writing space.
- Necessary software requirements for computing facilities. R, for exercises, but not needed in class.
- Lecture/computer session/tutorial/discussion split (hours of each): 10 hours lectures (with some discussion).

Lecturer Details:

- Lecturer: Professor Michael Pitt
- Lecturer home institution: King's College London
- Lecturer e-mail: michael.pitt@kcl.ac.uk