LTCC Basic Course

Title: Fundamental Theory of Statistical Inference

Basic Details:

- Core Audience: 1st year Statistics PhD students.
- Course Format (extended or intensive): Basic course, extended (10hr).

Course Description:

- Keywords: Bayesian methods, data reduction, decision theory, Fisherian statistics, frequentist inference, likelihood.

- Syllabus:

(1) Approaches to statistical inference: frequentist, Bayesian, Fisherian. [1]
(2) Decision theory: risk, utility, decision rule, criteria for a decision rule, minimax, Bayes rules. [2]
(3) Bayesian methods: fundamental ideas, general form of Bayes rules, choice of prior, empirical Bayes, hierarchical modelling, computational ideas. [2]
(4) Special families of models: exponential families, transformation families. [2]
(5) Principles of inference and data reduction: sufficiency, completeness, ancillarity, likelihood. [1]
(6) Key elements of frequentist theory: Neyman-Pearson, optimal testing and estimation. [2]

Recommended reading:

D.R. Cox. 'Principles of Statistical Inference'. Cambridge University Press, 2006.
G.A. Young and R.L. Smith. 'Essentials of Statistical Inference'. Cambridge University Press, 2005

Additional Optional reading:

M.J. Bayarri and J. Berger (2004). The interplay between Bayesian and frequentist analysis. Statistical Science, 19 , 58–80.
J. Berger (2003). Could Fisher, Jeffreys and Neyman have agreed on testing (with discussion)? Statistical Science, 18 , 1–32.
B. Efron. (1998). R.A. Fisher in the 21st Century (with discussion). Statistical Science, 13 , 95–122.

Prerequisites: basic knowledge of ideas of statistical inference (hypothesis testing, estimation, confidence sets), distribution theory (standard distributions, relationships between them, in particular those associated with normal distribution).

Preliminary reading: Chapters 1-12 of L. Wasserman 'All of Statistics: A Concise

Course in Statistical Inference' (Springer, 2003) would provide very suitable revision of background probability material, as well as introduction to key inferential ideas of the course, and would serve as a further useful reference. The course is modestly advanced, and should be viewed as a `second course' on statistical inference, with emphasis on comparisons between paradigms.

Format:
- No of problem sheets: a single problem sheet, containing comprehensive exercises for each section will be given, with solutions at the end of the course or as requested.
- Electronic lecture notes: lecture material will be made available for download.
- Proposed timing: Autumn.
- Lecture/computer session/tutorial/discussion split: the 10hr will be split as indicated in the syllabus, but each section will contain extensive discussion of example sheet material.

Lecturer Details:

- Lecturer: Alastair Young (alastair.young@imperial.ac.uk)
- Lecturer home institution: Imperial College London