Lecture: Thursday 13 December, at 6 pm, Faculty Hall, Faculty of Food Technology

LINEAR AND NONLINEAR MODELING IN FOOD TECHNOLOGY: LESSONS AND NEW ADVANCES

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Abstract:

We review lessons of statistical learning in science and technology from examination of properties of linear and nonlinear models. For linear models, we discuss two examples, one is typical of scientific comparisons done in food technology (in this case, determination of the best solvent for extraction of certain bioactive molecules). The other example is the assessment of fairness to gender in university admission. For nonlinear models, we discuss the proper fitting of models of adsorption processes of bioactive molecules.

The first lesson is that a simple T test can fail to be properly revealing in a scientific comparison, because, in the simplest case, it does not properly account for other relevant characteristics. For example, questions of which solvent to use in the extraction of polyphenols from apples can depend on the type of apple, whether it is an extract of peel or flesh, or the types of polyphenol one wants to measure. We show how linear models can properly account for such relevant covariates to reduce the within-group standard deviations and better reveal the distinctions in types of solvent. Similar issues arise in the study of gender differences in college admission. In this case, accounting for admissions at the level at which decisions are made (e.g. schools or departments within a university) is essential in proper assessment of difference. In total, a university can appear to favor one gender, when, in fact, within each group it is neutral or favors the other gender.

A second lesson concerns nonlinear modeling of adsorption processes as commonly occur in steps of digestion and other biochemical processes, in which small bioactive molecules (e.g. polyphenols) can adsorb in varying amounts onto larger molecules (e.g. soluble fibers such as β glucan). Adsorption models relate the amount of specified bioactive molecules that are adsorbed to the concentration not adsorbed for each of several experimentally-specified initial amounts, at given physiological conditions (e.g. temperature and acidity). Traditional fitting of adsorption isotherms by nonlinear regression suffers from a statistical inconsistency that we overcome with new developments in nonlinear modeling tailored to this setting.

Curriculum Vitae:

Andrew R. Barron has served as Professor at Yale University in the Department of Statistics since 1992, including terms as Chair, Director of Undergraduate Studies, and Director of Graduate Studies in the Department. Prior to his tenure at Yale, he was a Professor at the University of Illinois in the Departments of Statistics and Electrical and Computer Engineering. His Bachelor degree is from Rice University in the fields of Mathematical Sciences and Electrical Engineering and his Masters and PhD degrees are from Stanford University (USA) in Electrical Engineering in 1985, with specialization in the role of Information Theory in the fields of Probability and Statistics. He is a Medallion Award winner of the Institute of Mathematical Statistics, a Fellow of the IEEE, and has served several terms on the Board of Governors of the Information Theory Society. He has more than 80 publications, two patents, numerous invited presentations and has supervised 19 PhD dissertations. His research interests include entropic central limit theorems, the minimum description length criterion for model selection, analysis of statistical risk of Bayes procedures, optimal rates of function estimation, greedy algorithms, and deep learning networks.