Abstracts:

Optimal Detection of Changepoints with a Linear Computational Cost
Professor Paul Fearnhead, Lancaster University (joint work with Prof Idris Eckley and Rebecca Killick)

We consider the problem of detecting multiple changepoints in large data sets. Our focus is on applications where the number of changepoints will increase as we collect more data: for example in genetics as we sequence larger regions of the genome, or in finance as we observe time-series over longer periods. We consider the common approach of detecting changepoints through minimising a cost function over possible numbers and locations of changepoints. This includes most common procedures for detecting changing points, such as penalised likelihood and minimum description length. We introduce a new method for finding the minimum of such cost functions and hence the optimal number and location of changepoints, that has a computational cost which, under mild conditions, is linear in the number of observations. This compares favourably with existing methods for the same problem whose computational cost can be quadratic, or even cubic. In simulation studies we show that our new method can be orders of magnitude faster than these alternative methods. We also compare with Binary Segmentation and a genetic algorithm for finding changepoints, and show that the exactness of our approach can lead to substantial improvements in the accuracy of the inferred segmentation of the data.

A New Perspective On Feasibility Determination With Linear Constraints
Professor Roberto Szechtman, Naval Postgraduate School, US (joint work with E. Yucesan (INSEAD))

We consider the problem of feasibility determination in a stochastic setting. In particular, we wish to determine whether a system belongs to a given set based on a performance measure estimated through Monte Carlo simulation, for the case when the constraint set is a d-dimensional polyhedron. We characterize fractional allocations that are asymptotically optimal, and we provide an easily implementable algorithm, rooted in stochastic approximation theory, that results in sampling allocations that provably achieve in the limit the same performance as the optimal allocations.

Dynamic Modelling of Workflows
Dr Michael Lyons, BT

This paper outlines the use of system dynamics to understand work flows within BT. The talk describes how simple models of throughput and cycle times have been used by operational managers for e.g. resource planning.

MBDA Guidance, Control and Navigation (GCN) Department: Overview of Activities
Dr Dave Vorley, MBDA (Bristol)

This talk will briefly describe work carried out within the Guidance, Control, Navigation & Image Processing Department of MBDA (UK), based at Filton near Bristol. It will also consider the application of basic techniques relating to Kalman filtering and some extensions and alternatives and discuss data fusion and multi-target tracking.

Focussed Information Criteria for Model Selection and Model Averaging
Professor Nils Hjort, University of Oslo, Norway

The traditional approaches to model selection, e.g. those based on the Akaike and Bayesian information criteria (AIC and BIC), work in “overall modus”, without considering what the selected model actually may be used for later in the inference process. I shall discuss various versions of focussed information criteria (FIC) for different types of situations, where the operating idea is to take explicitly on board what the focus of the analysis is. Thus I decide to not see it as particularly contradictory that one model may be best for analysing say the mean structure whereas another model may be better for analysing say the skewness structure (with the same set of data and the

same list of candidate models). I will first review the basic FIC machinery developed in joint earlier work with Gerda Claeskens (cf. several JASA papers and our 2008 CUP book) for the case of comparing (and averaging over) a class of parametric candidate models and then present some ongoing work with one of my Oslo students, pertaining to FIC comparisons between parametric and nonparametric models. Such problems are of a different character in that one needs to compare models with likelihoods with models without likelihoods.

Stochastic scheduling: A short history of index policies and some key recent developments

Professor Kevin Glazebrook, Department of Management Science, Lancaster University Management School

A multi-armed bandit problem concerns $N \geq 2$ independent populations of rewards whose statistical properties are unknown (or at least only partly known). A decision-maker secures rewards by sampling sequentially from the populations, using past sampled values to make inferences about the populations and so guide the choice of which population to sample next. The goal is to make these choices in such a way as to maximise some measure of total reward secured. Such problems embody in a particularly simple form the dichotomy present in many decision problems between making decisions with a view to securing information which can improve future decision-making (exploration) and those which exploit the information already available (exploitation). In the 1970s John Gittins discovered that important classes of such multi-armed bandit problems have solutions of a particularly simple form: at each stage of the sampling compute an index (the Gittins index) for each of the N populations, namely a function of the rewards already sampled from the population concerned. Always sample next from the population with the largest index. Moreover, the index concerned has a simple interpretation as an equivalent known reward for the population concerned. It emerges that many problems involving the sequential allocation of effort, some of quite different character to the above multi-armed bandit problems, have index solutions. Since the 1970s, Gittins' index result together with a range of developments and reformulations of it have constituted an influential stream of ideas and results contributing to research into the scheduling of stochastic objects. Application areas to which these ideas have contributed include approximate dynamic programming, the control of queuing systems , fast fashion retail, machine maintenance, military logistics, optimal search, research planning, sensor management, communication channel usage and website morphing. The talk will give an overview of some key ideas and some recent developments.