Available projects with Ben Stevenson

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Please e-mail me at ben.stevenson@auckland.ac.nz if you are interested in any of the projects listed below.

A comparison of spatial capture-recapture and random encounter models for camera trap data

Camera-trap surveys are commonly used to estimate density of wildlife populations. Over the last decade, spatial capture-recapture (SCR) and random encounter models (REMs) have gained traction in their application to the resulting data. They each require slightly different information—for example, SCR usually needs individuals to be recognised when they are detected, while REMs usually require a priori knowledge of average animal speeds. The two methods also make different assumptions about the way animals move and behave. In this project, we will assess the performance of SCR and REM estimators in terms of properties such as bias, precision, and robustness to assumption violations.

Requirements: An interest in programming, with good grades in statistical computing papers.

Parameter estimation for void point processes

Spatial point processes model the observed locations of objects or events. They can explain patterns in the locations of stars, animals, earthquakes, criminal acts, and terrorism attacks, to name just a few applications. Jones-Todd et al. (in press) described a new type of spatial point process, the void process, which was used to model spatial patterns formed by cancer cell nuclei on tissue slides from colon cancer patients. A void process comprises two types of points, Type A and Type B, which are uniformly scattered with intensities $\lambda_A$ and $\lambda_B$, respectively. Type B points are not observed at all. Only Type A points that are greater than distance $\tau$ from all Type B point are observed. In other words, each hidden Type B point ‘deletes’ any Type A point within its ‘void’ of radius $\tau$. Jones-Todd et al. (in press) proposed estimation of $\lambda_A$, $\lambda_B$, and $\tau$ via maximum Palm likelihood. Although this is a computationally efficient approach, it does not appear to be particularly statistically efficient. In this project, we will will develop a Bayesian (or possibly a maximum likelihood) estimator for void processes.

Requirements: A good grade in STATS 331 or STATS 731. A good grade in STATS 310 would also be an advantage.

Score-based residuals to assess goodness-of-fit for hierarchical models

Hierarchical models relax the independence assumption of standard statistical models, like GLMs, by modelling dependence between observations. Due to advancements in computing technology and statistical methodology, they have become increasingly popular in population ecology—but, in some cases, the development of diagnostic tools to assess how well the models fit the data has lagged behind. In this project, we will develop a new diagnostic tool to assess goodness-of-fit for hierarchical models, and test it out on examples from the population ecology literature. Potential applications vary in complexity from simple GLMs, to models that estimate density and distribution of snow leopards from photographs taken by camera traps, and of whales from visual detections by shipboard observers.

Requirements: Familiarity with maximum likelihood estimation and generalised linear models; good grades STATS 310 and 330 would suffice. An interest in R programming.