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. This project will aim to assess the performance of SCR and REM estimators in terms of properties such as precision and robustness to assumption violations.

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

Robustness of spatial capture-recapture models

Spatial capture-recapture (SCR) models can be used to estimate animal density from various kinds of detection data. SCR is known to be remarkably robust to various model misspecifications, but this has usually been shown for surveys that deploy a large number of traps. Acoustic detection is becoming a popular means of monitoring animal populations, and SCR methods can be applied to the resulting data. However, these surveys often only deploy around 2–6 recorders. This project will investigate whether the same robustness results hold once we consider detector arrays of this scale. There are potential applications of this work to acoustic data of frogs in South Africa and/or whales in the Pacific Ocean.

Requirements: An interest in programming.

Who’s skating on thin ice? Evaluating the performance of hockey goaltenders in the NHL

North American sports are well known for their meticulous recordkeeping, and ice hockey is no different. Vast quantities of data are collected from the performance of every player who steps onto the ice during an NHL match. The goaltender (or ‘goalie’) is an important player who attempts to prevent the opposition from scoring by blocking shots directed at their goal. The save percentage (SP) is a key summary statistic that is commonly used to measure goaltender performance. However, comparison of the SP either between players (to assess who is better) or within a single player (to assess how performance changes over time) is typically achieved simply by seeing which is bigger, without any regard for sampling variation. This project aims to model goaltending performance in order to answer various questions, which may include some of the following:
1. How much better is a ‘good’ goaltender than a ‘bad’ one? How much does a ‘good’ goaltender improve the performance of their team?

2. How does goaltender skill vary across a career? Is there an optimal age?

3. Do goaltenders with higher salaries actually perform any better? Is it better to hire an older, experienced, expensive goaltender, or a younger, inexperienced, cheap goaltender?

4. What role does form play? For example, how does a good goaltender on a bad day compare to a bad goaltender on a good day?

5. Is it possible to predict how well a goaltender will perform based on recent performances? In other words, do goaltenders go through cycles of ‘good’ and ‘bad’ form? If so, should a coach pick their best goaltender in ‘poor’ form or a back-up goaltender in ‘good’ form?

6. If a coach deems that the starting goaltender is performing poorly in a match, they may be ‘relieved’ by the back-up goaltender. When this occurs, how often is the goaltender truly performing poorly, and how often have they just gotten unlucky? Is there any evidence to suggest back-up goaltenders perform any better, or does being introduced mid-game negatively affect their performance?

Requirements: At least two of the following would be beneficial, but a particularly good student could get away with fewer: (1) Experience with hierarchical models (or ‘latent variable models’ or ‘mixed effects models’). (2) A good grade in statistical inference papers, such as STATS 310 and/or STATS 730. (3) Some experience using Template Model Builder (TMB). (4) A good understanding of ice hockey.

A field test for blue whale call density estimation

Collaborators at Southwest Fisheries Science Centre in San Diego, California, USA, have conducted a playback experiment to investigate the potential for estimating blue whale (Balaenoptera musculus) call density from detections of their calls. Four sonobuoys were deployed, and synthetic blue whale calls were played at various locations from an underwater speaker. The aim of this project is to analyse detections of the playbacks at the sonobuoys and evaluate how well the fitted models are able to account for the detection process.

Requirements: Good R programming and written communication skills.