$$\pi(\theta|x) = \frac{f(x|\theta)p(\theta)}{f(x)}$$

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$$f(\boldsymbol{x}|N, \boldsymbol{\theta}, \boldsymbol{\epsilon}_{1:n}) \propto \prod_{i=1}^{n} f(\boldsymbol{x}_i|\boldsymbol{\theta}, \boldsymbol{\epsilon}_i) \times \frac{N!}{(N-n)!}(1-p^*)^{N-n}$$

Who am I?

- I am an applied statistician – motivated by real data and associated questions of interest.
- To answer the questions we need to:
  - develop sensible and realistic models that describe the main underlying characteristics of the data;
  - fit these models to data in a tractable manner; and
  - interpret the data accordingly.

Research interests

- Bayesian inference;
- Missing data (a very common problem!);
- Hidden (semi-)Markov models (these are really cool!);
- State-space models;
- Incorporating individual heterogeneity;
- Integrated models;
- Applications to ecology and epidemiology.

Ecology

- The field of ecology is very data rich (think of all the times your biology colleagues are on fieldwork!).
- However, there is often as associated lack of skills to fully analyse the collected data.
- New statistical models and associated model-fitting tools are rapidly being developed to provide robust analyses of the available data.

Case study 1

- Capture-recapture studies are often collected on wildlife populations when abundance and/or survival rates are of interest.
- These involve observers going into the field at a series of capture events.
- At each capture event all observed individuals are uniquely identified (possibly by attaching a ring/tag), recorded and released.

Data

- The data correspond to the encounter history of each individual observed within the study.
- An example encounter history:

1 0 0 0 1 1 0 2

- Additional individual-level information may also be recorded e.g. weight, “state”.

Questions of interest

- How can we sensibly model both time and age-dependence on survival in a parsimonious manner?
- How can we incorporate state dependent survival rates when individuals move between states?
- Do individuals exhibit “memory” with regard to their movement? And if so how can we also include additional covariate information?
- Given the above models, how can we efficiently fit the models to real data?

Case study 2

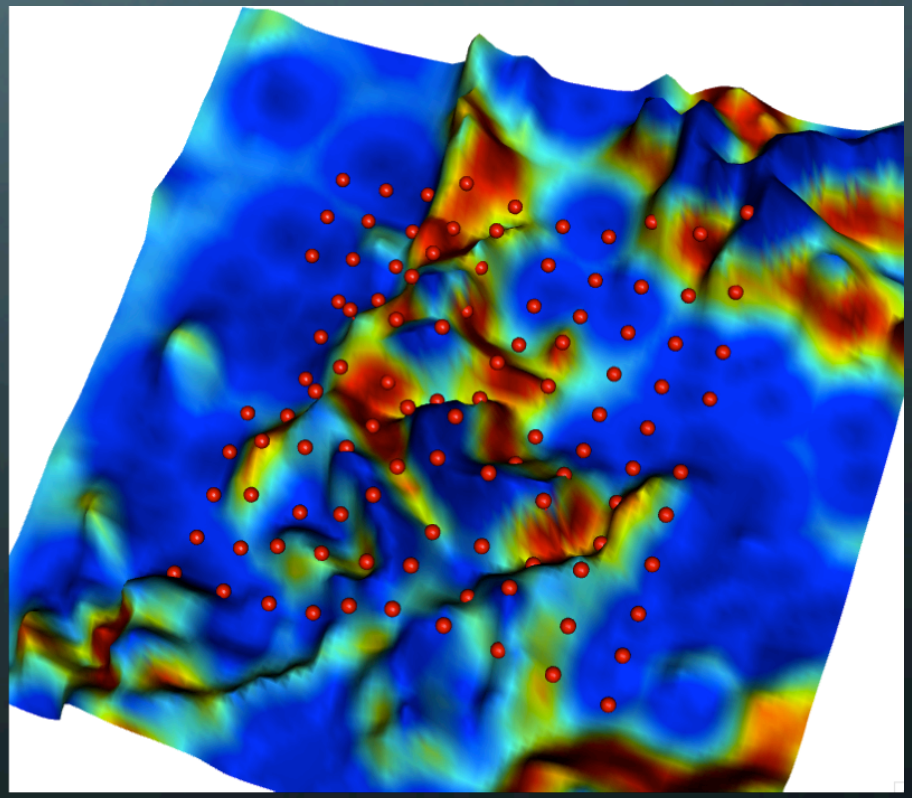
- For wildlife management/conservation data are often collected on individual animals.
- These often take the form of trapping or observing animals via a series of “traps”:

Spatially explicit capture-recapture

- The capture probability of individuals differ over traps – dependent on the home-range of the individual.
- Traditionally, the capture probability is simply specified as a function of the fixed (unobserved) home-range centre of the individual.
- This ignores the known locations of the individuals from observed trappings/sightings, so that:
  - Information is thrown away (poor practice);
  - It implicitly allows animals to “teleport”.

Output

- The output of the statistical analysis is in the form of an estimated density for the population (in terms of home range centres).



Questions of interest

- How can we incorporate information relating to known observed locations of individuals (i.e. when trapped) into the analysis?
- What happens if the animals under study are territorial/social (i.e. non independent individuals)?
- How can we incorporate “moving” home range centres?
- How do we incorporate inhomogeneous landscapes?
- How can we fit the models efficiently?

Thankyou!

- If you want to know more – come and ask!