Introduction to the Course

Models for Socio-Environmental Data

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SESYNC

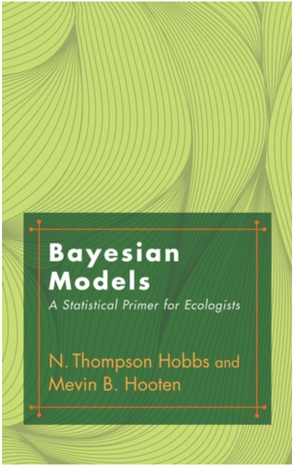
Housekeeping

- Introductions
- Website for course materials
- Getting notes just in time
- Daily schedule
- Lecture / exercise mix

Pace

- Working in groups
- Questions, questions, questions
- Advanced problems
- A flexible schedule
- Opportunity to read and study

Readings

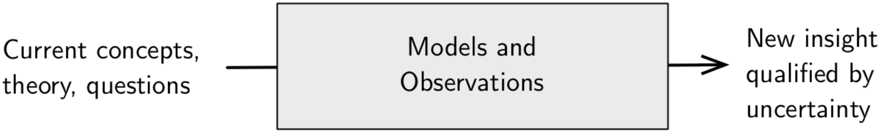


Errata and explanations can be found here

Exercise

What do statements made by journalists, attorneys, and scientists have in common? What sets the statements of scientists apart?

What is this course about?



What is this course about?

Gaining insight about socio-ecological systems by building models

$$[z_i \mid \theta_p]$$

and fitting those models to data

$$[y_i \mid z_i, \theta_d]$$

using Bayesian methods.

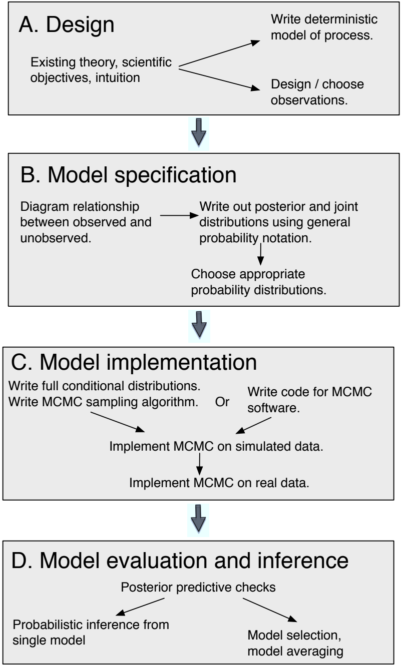
Goals

- Provide *principles* based understanding
- Enhance intellectual satisfaction
- Foster collaboration
- Build a foundation for self-teaching

Learning outcomes

- Explain basic principles of Bayesian inference.
- Diagram and write out mathematically correct posterior and joint distributions for Bayesian models.
- Explain basics of the Markov chain Monte Carlo (MCMC) algorithm.
- Use software for implementing MCMC.
- Develop and implement hierarchical models.
- Evaluate model fit.
- Understand papers and proposals using Bayesian methods.

Learning outcomes



Topics

Day 1 - 2

Principles

- Rules of probability
- Distribution theory
- Likelihood
- Moment matching
- Bayes' theorem
- Conjugate priors

Day 3 - 8

Implementation

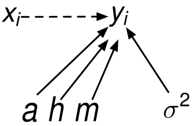
- MCMC
- JAGS
- Regression
- Hierarchical models
- Model checking

Day 9 - 11

Advanced topics

- Model selection
- Designed experiments
- Mixture models
- Ordinal regression
- Dynamic models
- Spatial models
- Individual problems

Cross cutting theme



$$\mu_i = \frac{m x_i^a}{h^a + x_i^a}$$

$$[a, h, m, \sigma^2 \mid \mathbf{y}] \propto \prod_{i=1}^{n} [y_i \mid \mu_i, \sigma^2][a][h][m][\sigma^2]$$

```
model{
  a ~ dnorm(0, .0001)
  m ~ dgamma(.01, .01)
  h ~ dgamma(.01, .01)
  sigma ~ dunif(0, 5)
  for (i in 1:length(y)){
    mu[i] <- (m * x[i]^a) / (h^a + x[i]^a)
    y[i] ~ dgamma(mu[i]^2 / sigma^2, mu[i] / sigma^2)
  }
}
```