Introduction to the Course

Bayesian Models for Ecologists

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Plan for today

- First session
  - Housekeeping
  - Overview of course
  - Introductions
  - Rules of probability
- Second session
  - Probability distributions

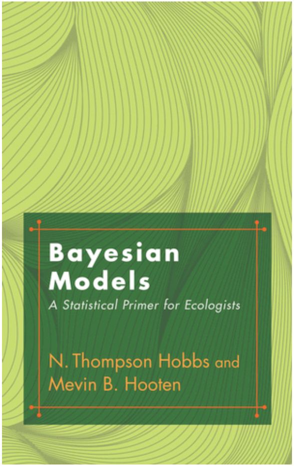
Housekeeping

- Website for course materials here. Be sure to review the Logistics tab today.
- Course Slack channel here
- Getting notes just in time
- Daily schedule
  - Start 9:00 sharp
  - Catered lunches daily
  - Coffee and snacks $\approx$ 10:30, Coffee $\approx 3:00$
  - Finish $\approx$ 5:00
- Lecture / exercise mix
- Working in groups

Pace

- Questions, questions, questions
- Advanced problems
- A flexible schedule

Readings



Errata and explanations can be found here

Evaluating lectures and labs

1) Not informative.
2) Too advanced. Partially informative.
3) Too elementary. Partially informative.
4) Clear as expensive gin. Informative.

Sexual harassment

Report to the Colorado State University Office of Title IV Programs and Gender Equity

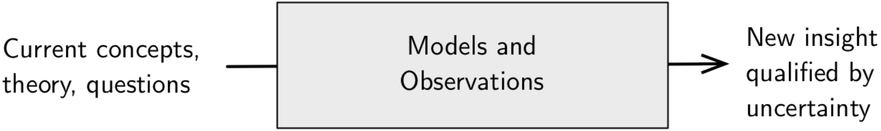
https://titleix.colostate.edu/

970-491-1715

Student recreation center

A very nice facility for exercising is available to you for \$5 per day. Just show your meal card and pay at front desk.

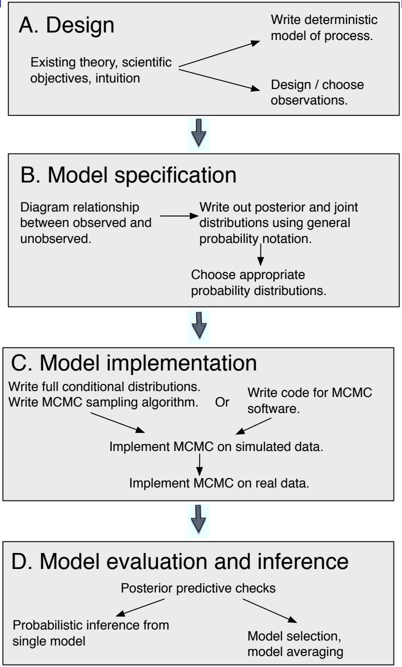
What is this course about?



Many problems, a single modeling approach

- Jolly-Seber model of Hawaiian nene using Pollock's robust design
- Matrix model of Brucellosis in Yellowstone bison
- Ricker model of effects of predators on reindeer population dynamics in Scandinavia
- Hierarchical glm for NPS inventory and monitoring data
- Hierarchical glm for effects of wolves on willows in Yellowstone
- Double observer, distance sampling, N-mixture model of moose population size in Rocky Mountain National Park

A single approach



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.

Sequence

What is probability? → Advanced models

Day 1 - 4

Principles

- Rules of probability
- Distribution theory
- Likelihood
- Moment matching
- Bayes' theorem
- Priors and conjugate priors

Day 5 - 9

Implementation

- MCMC
- JAGS
- Regression
- Model checking
- Model selection
- Multi-level models
- Writing hierarchical models
- More about priors
- Missing data

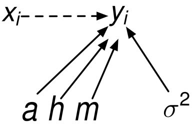
Day10 - 11

Concurrent Sessions

- Occupancy and Capture-Mark-Recapture
- Dynamic Models
- Spatial Models
- Catchup

Graduation challenge

Cross cutting theme



$$
\begin{aligned}
\mu_i &= \frac{m x_i^a}{h^a + x_i^a} \\
[a, h, m, \sigma^2 \mid \boldsymbol{y}] &\propto \prod_{i=1}^{n} [y_i \mid \mu_i, \sigma^2][a][h][m][\sigma^2]
\end{aligned}
$$

```
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)
  }
}
```