



Methods in Experimental Ecology II

Methods in Experimental Ecology I

Experimental Design and Pseudo-replication
Data with normal errors
Summary statistics
Confidence Intervals
Regression
Model Selection approaches



Statistics



Mathematics

**Computer
Science**



Methods in Experimental Ecology II

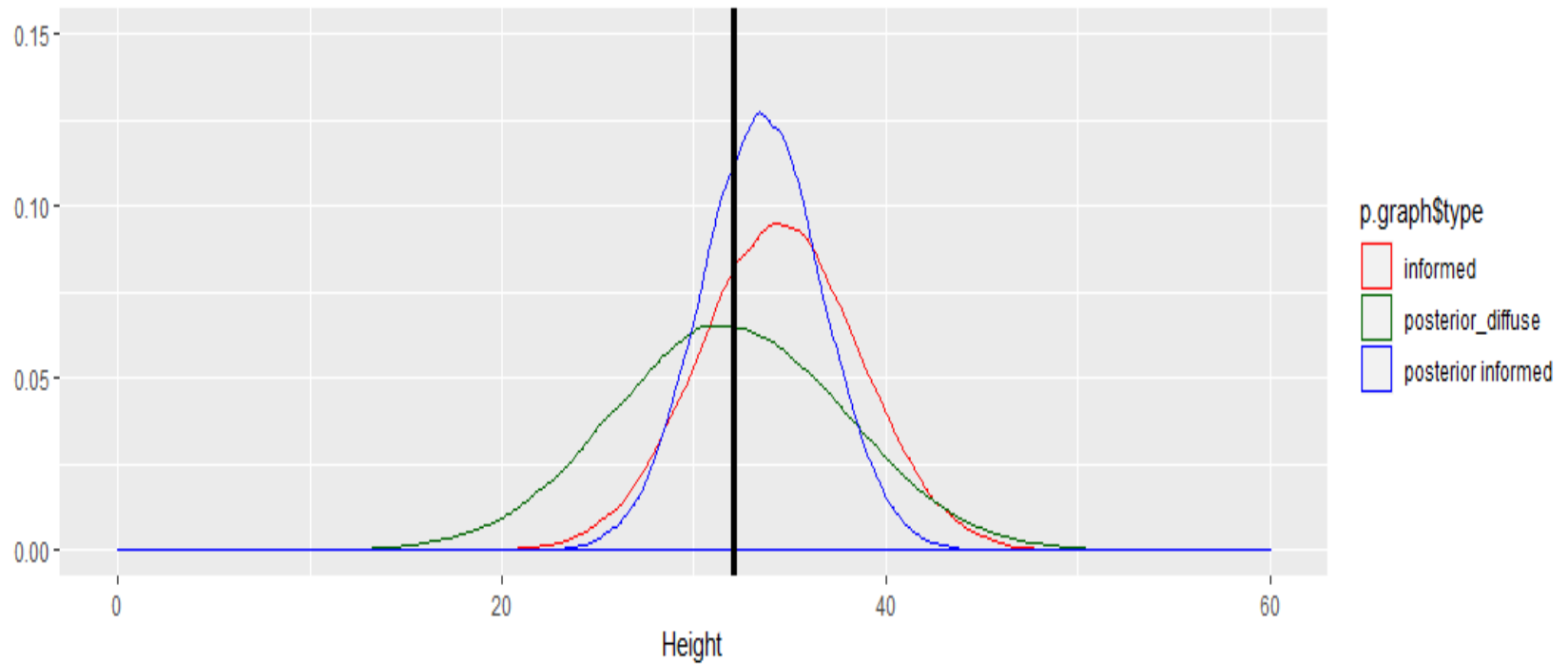
Bayesian approaches
Complex data
General Linear Mixed Models
Non-linear Models
Decision-making process

Approach

- Understanding the attributes of the data
- Implementation of analysis
- Identification of model limitations
- Understanding different approaches
- Application to case studies



Bayesian Analysis



Session	TOPIC	Class dates / return exercise
0	Class presentation	January 11
1	Why spend time with stats?	January 13
	Exercise 1 (and Extra Credit)	January 18
2	Why to worry about assumptions?	January 18-20
	Exercise 2	January 25
3	Three Frameworks of Analysis	January 25-27
	Exercise 3	February 1
4	Why Bayesian? The model of the mean	February 1-3
	Exercise 4	February 8
5	How to analyze binary responses?	February 8-10
	Exercise 5	February 15
6	How to analyze non-linear relationships?	February 15-17
	Exercise 6	February 22
7	How to deal with count data?	February 22-24
	Exercise 7	March 1
8	Why linear mixed models?	March 1-3
	Exercise 8	March 8
9	Model selection for mixed models	March 8-10
	Exercise 9	March 22
	Spring break	March 15-17
10	Model selection for mixed models II	March 22-24
	Exercise 10	March 29
11	Models for data with too many zeros	March 29-31
	Exercise 11	April 5
12	Non-linear count data	April 5-7
	Exercise 12	April 19
13	TBD	April 12-14
	Exercise 13	April 21
	Closing remarks-Optional topics	April 19-21

R and RStudio



- **While you can use any platform you feel comfortable with...**
- **... we will teach using R because:**
 - ♦ It's free
 - ♦ It has reasonable documentation online
 - ♦ It's flexible
 - ♦ It has many application for biological purposes

Stan



- **While you can use any platform you feel comfortable with...**
- **... we will teach using STAN because:**
 - ♦ It's free
 - ♦ It has reasonable documentation online
 - ♦ It's flexible and stable



Stan and Rethinking

- rstanarm:

```
fit <- stan_glm(NestsPerQuadrat ~ Habitat, data = nd)
```



Stan and Rethinking

- stan:

```
data{
  int<lower=1> N;
  real NestsPerQuadrat[N];
  real Forest[N];
}
parameters{
  real a;
  real b;
  real<lower=0,upper=100> sigma;
}
model{
  vector[N] mu;
  // sigma ~ uniform( 0 , 100 );
  b ~ normal( 0 , 100 );
  a ~ normal( 0 , 100 );
  for ( i in 1:N ) {
    mu[i] = a + b * Forest[i];
  }
  NestsPerQuadrat ~ normal( mu , sigma );
}
generated quantities{
  vector[N] mu;
  for ( i in 1:N ) {
    mu[i] = a + b * Forest[i];
  }
}
```



Stan and Rethinking

- rethinking:

```
model2 <- map2stan(  
  alist(  
    NestsPerQuadrat ~ dnorm(mu, sigma),  
    mu <- a + b*Forest,  
    a ~ dnorm(0, 100),  
    b ~ dnorm(0, 100),  
    sigma ~ dunif(0, 100)  
  ),  
  data = nd, chains = 3,  
  start = list(a=1, b=1, sigma=10)  
)
```