

# Experimental design and hierarchical model building with Bayesian inference — Winter 2020

Class: Thursdays 13:00-14:30 PST – FSC 3003  
Leader: Elizabeth Wolkovich (e.wolkovich@ubc.ca)

Date	Topic	Reading (pp)	ARM (optional)	Leader
Jan 9	Intro/organizing			
Jan 16	Small world & sampling	Ch 1-3 (1-69)	Ch 7-8	Faith & Mira, Projects (all)
Jan 23	Linear models	Ch 4 (71-117) <sup>1</sup>	Ch 3-4	Mira & Geoff, Dan presenting
Jan 30	Projects			Cat & Faith
Feb 6	Overfitting etc.	Ch 5-6 (119-188) <sup>2</sup>		Cat & Dan
Feb 13	Projects			Mira & Geoff
17-21	Break			
Feb 27	Interactions, MCMC	Ch 7-8 (209-263)	Ch 9; BDA3: Ch 11-12	Faith & Mira
Mar 5	GLM, counts to mixtures	Ch 9-11 (267-352)	Ch 6	Geoff & Mira
Mar 12	Projects			Dan & Faith
Mar 19	Multi-level models	Ch 12 (355-384)	Ch 11-15	Dan & Cat
Mar 26	Projects			Mira & Geoff
Apr 2	Covariance	Ch 13 (387-419)		Faith & Mira
Apr 9	Projects			Open (for now)

**Course materials:** There is one course textbook: *Statistical Rethinking* by MacElreath (more info here). Another book you might consider purchasing for reference: *Data Analysis Using Regression and Multilevel/Hierarchical Models* by Gelman & Hill (more info here); note that I refer to this book as **ARM** or Gelman & Hill. Finally, *Bayesian Data Analysis*, sometimes called the ‘Bible’ for Bayesian stats has a lot in it and has several editions (BDA3 means the third edition).

**Where do I find the data/code/etc. from the book?** Info on the book (including the author’s lectures, and the book’s code) can be found at: <http://xcelab.net/>

<sup>1</sup>Please also review prior predictive checks/simulation; pages 82-92 in statisticalrethinking2.pdf and can also check section 2.1 here [https://betanalpha.github.io/assets/case\\_studies/principled\\_bayesian\\_workflow.html](https://betanalpha.github.io/assets/case_studies/principled_bayesian_workflow.html) if you want more details.

<sup>2</sup>Chapter 6: You can skip information theory if you want (though it comes up more in the book so you may want to skim it).

`rm/statistical-rethinking/`. To install the `rethinking` package in R, you must install from git following the instructions here: <https://github.com/rmcelreath/rethinking>.

**What is this whole leader thing?** Most reading class periods will have a team of leaders. This means the week you are leader you will be in charge of highlighting the main points of the reading through one or two practice problems that you walk through the class with. These can be ones you develop yourself (e.g., using your own data) or can be from the problems at the end of the chapters(s). Whatever you do, you will have up to **30 minutes of class time**.

**Project description** Build simulated data for a hierarchical model including at least two grouping factors (e.g., year and vineyard or vineyard and block), then fit a hierarchical model in R and Stan. Then using winegrape phenology data, clean and visualize data and fit a model to it. Evaluate model output both in terms of how well the model fits and what it tells us biologically.

**Missing classes:** You can miss up to one class without it impacting your grade. You cannot miss a class where you are a named ‘leader’ or where you are presenting. Note that we will cover a lot in each class and you are responsible for catching up on what you miss.

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### Grading:

In-class participation*	60 points
Final code and simple write-up of project	40 points
Total	100 points

Note that a good grade for in-class participation means: Meet weekly and show proficiency in reading though answering questions, asking questions and presenting modeling progress related to the chapter