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Science Tools

- [Free images & icons](#)

Learning/Tutorials

R & general modeling/analysis books, guides, and courses

- EFI [Resource Repository related to ecology/stats/R](#)
- [Big Book of R](#)
- [R Cookbook, 2nd Edition](#)
- [Guide to R for Graduate Students](#) (with [keyboard shortcuts](#))
- [Intro2R](#)
- [Data Analysis in the Geosciences](#)
- [R for Ecology website](#)
- [Primer of Ecology using R](#) (book, Hank Stevens)
- [Multivariate data analysis with R and vegan](#)
- [Analysis of community ecology data in R](#)
- [Little Book of R for Multivariate Analysis](#)
- [Data Analysis in R](#) (book, Steve Midway)
- [Modern Statistics with R](#) 2nd edition (Thulin, 2024)
- [Introduction to Modern Statistics \(2e\)](#) (Çetinkaya-Rundel and Hardin)
- [Statistical Inference via Data Science: A Modern Dive into R and the Tidyverse](#) (Ismay et al.)
- [Exploring Modeling with Data and Differential Equations Using R](#) (includes IVPs, equilibrium and stability analyses, parameter estimation, probability distributions and likelihood functions, bootstrapping, MCMC, eigenvalues, systems of DEs, stochastic DEs, etc.)
- [An R companion to Statistics: Data Analysis and Modelling](#) (book, Speekenbrink, 2023)
- [Design and Analysis of Experiments and Observational Studies using R](#) (book, Taback)

- [Seeing Theory](#) A visual intro to probability & stats
- [EFI Statistical Methods Seminar Series](#) (awesome!)
 - [EFI Task Views](#)
 - [Uncertainty quantification, Data assimilation, Modeling & Statistics](#)
 - [Visualization, Decision Support, and User Interfaces](#)
- [Doing Meta-Analysis in R](#) (book, Harrer et al.)
- [Simulating data for model exploration in R](#)
 - [A step-by-step guide to making sense of complex models using data simulations](#)
 - <https://lmu-osc.github.io/synthetic-data-tutorial/>
- Ava Hoffman's: [catch-all location for free data science resources](#)
- Power analysis
 - [Power Analysis \(tidy\)](#)
 - <https://designexptr.org/powchpt.html>
 - [Simulations for Advanced Power Analyses](#) (book, LMU Open Science Center)
- AI/ML
 - [Machine Learning](#) (book, Samuel Jackson, also covers GAMs)
 - [Feature Engineering A-Z](#) (book, Hvitfeldt)
 - Also includes lots of general multivariate stats, like [PCA section](#)
 - List of [ML/DL resources](#)
 - [Machine Learning Modeling in R cheat sheet](#)
 - [MLR Cheat Sheet](#)
 - [Machine learning in marine ecology: an overview of techniques and applications](#)
 - [Zotero library of ML papers in ecology](#)
 - <https://thegardens.ai/#/>
 - [Tidy Modeling with R \(tidymodels.org\)](#)
 - [Efficient Machine Learning with R](#) (book about improving efficiency of tidymodels, by Simon Couch)
 - [Intro to tidymodels](#) blog post by Rebecca Barter
 - LLMs
 - [AI for the Skeptical Scholar: Practical Strategies for Using LLMs in Research](#) (Emery)
 - [Large Language Model tools for R](#) (Verde Arregoitia)
 - [Local LLMs & GitHub Copilot for Enhanced R Package Development](#) (Mowinckel)
 - [Doing Data Analysis with AI](#) (Békés)
 - [Programming with LLMs](#) (posit::conf workshop website)
 - [Code Like a Pro with AI using GitHub Copilot](#) (Rebecca Barter)
 - [OpenAI Cookbook](#)
 - [Prompt engineering overview - Claude Docs](#)
 - [Prompt design strategies | Gemini API | Google AI for Developers](#)
 - [GAIDeT Declaration Generator](#)
- Causal inference
 - [Causal Inference in R \(book\)](#)

- [EBIO 5460: Causal Inference in Ecology](#) (Dee & Siegel)
- [Causal Inference: The Mixtape](#) (Cunningham)
- [Solomon Kurtz causal inference blog post series](#)
- <https://designexptr.org/causal-inference.html>
- Advanced R programming
 - [Advanced R](#) (Wickham)
 - [Functional Programming in R](#) (Altman, Behrman, & Wickham)
 - [Deep R Programming](#) (Gagolewski)
 - [Efficient R programming](#) (Gillespie & Lovelace)
 - [Mastering Software Development in R](#) (Peng, Kross, & Anderson)
 - [What They Forgot to Teach You About R](#) (Bryan et al.)
 - [Tidy design principles](#) (Wickham)
 - [R in Production](#) (Wickham)
 - [Writing performant code with tidy tools](#)
 - [ETC4500/ETC5450 Advanced R Programming](#)
 - [Reference a column name with a variable in dplyr](#)
 - See also [Standardizing Non-standard Evaluation in R | SESYNC](#)
 - [So... What's the deal with rlang, anyway?](#) (van Leemput, 2025)
 - [Reproducible Data Science in R: Flexible functions using tidy evaluation](#)
 - [Blog post about mapply/pmap](#) (Mowinckel)
- GLM/GLMM/etc.
 - Free ebooks
 - <https://ms.mcmaster.ca/~bolker/emdbook/>
 - [Applied GLMs and Multilevel Models in R](#) (Roback & Legler)
 - [Applied Biostatistics in R](#) (Jeffrey A. Walker)
 - [Modern Data Science with R](#) 3rd edition (Baumer et al., 2024)
 - [Regression Modeling](#) chapter
 - [Analyzing Data using Linear Models in R](#) (van der Berg, 2024)
 - [Applied Regression Analysis](#) (Rawlings et al.)
 - [Regression and Other Stories](#) (Gelman et al.)
 - Accompanying book: [Active Statistics](#) (book, applied regression and causal inference, Gelman & Vehtari)
 - [Advanced Regression Models with R](#) (book, Florian Hartig)
 - [Statistical Design and Analysis of Experiments with R](#) (Murphy, 2022)
 - [An Introduction to Statistical Learning](#) (James et al., 2023)
 - [Extended R Examples for A First Course in Design & Analysis of Experiments](#) (Oehlert, 2023)
 - [Mixed Models with R](#) (Clark)
 - [Basic Methods for Theoretical Biology](#) (Kooijman)
 - [7.4 GLM Inference Tests | Stat 340 Notes: Fall 2021](#) (Tupper)
 - [Model Selection and Multimodel Inference](#) (Burnham & Anderson, 2002)
 - [Improving Your Statistical Inferences](#) (Daniël Lakens)
 - [Getting started with the glmmTMB package](#)

- [Covariance structures with glmmTMB](#)
 - [Post-model-fitting procedures with glmmTMB models: diagnostics, inference, and model output](#)
- Marginal/conditional effects
 - <https://marginaleffects.com/>
 - [Bayesian](#)
 - [Marginalia](#) (Heiss, extremely detailed, great comparison b/w emmeans and marginaleffects)
 - [Comparisons and contrasts in emmeans](#) (package vignette)
 - [Marginal and conditional effects for GLMMs with {marginaleffects}](#) (Heiss)
 - [Working with Ordinal Ranks in {marginaleffects}](#)
- Other articles, blogs, etc.
 - [Tutorial: linear mixed-effects models](#) (Murray Logan, some R details outdated)
 - [Vignette: Multilevel Correlations](#)
 - [GLMM FAQ](#) (very extensive)
 - [Linear Models, ANOVA, GLMs and Mixed-Effects models in R](#) (r-bloggers)
 - [R packages & functions for fitting different types of regression models](#)
 - [R Handbook: Beta Regression for Percent and Proportion Data](#) (Mangiafico)
 - [Intro to Poisson, Beta, & zero-inflated Beta Bayesian distributional regression models](#) (Heiss)
 - [Cross-validation FAQ](#) (Aki Vehtari)
 - [Common statistical tests are linear models \(or: how to teach stats\)](#) (Lindeløv, 2019)
 - [Generalized Multilevel Model for Examining Intraindividual Covariation](#)
 - [10 Fundamental Theorems for Econometrics](#) (Robinson, 2024)
 - <https://statmodeling.stat.columbia.edu/>
- Bayesian statistics
 - [Bayesian Data Analysis](#) (book, Gelman et al.)
 - [Bayesian data analysis course material](#) (Aki Vehtari)
 - [Statistical Rethinking \(2024 version\)](#)
 - [Bayesian inference with INLA](#)
 - [The brms Book: Applied Bayesian Regression Modelling Using R & Stan](#) (Bürkner, 2024)
 - [An Introduction to Bayesian Thinking](#) (Clyde et al., 2022)
 - [Bayes Rules! An Introduction to Applied Bayesian Modeling](#) (textbook, Johnson et al.)
 - [notebook translating all its code to {brms} and Stan](#) (Andrew Heiss)
 - [Non-normal hierarchical regression & classification w/ brms, rstanarm](#)
 - [Bayesian Methods for Ecological and Environmental Modelling](#) (course, UK Centre for Ecology & Hydrology)
 - [Comparing R packages for Bayesian modeling](#)
 - A different [Bayesian Statistics package comparison](#)
 - [Bayesian capture-recapture inference with hidden Markov models](#) (book, Gimenez)
 - Accompanying [workshop materials](#)
 - [Bayesian Hierarchical Models in Ecology](#) (book, Midway, 2019 - incomplete)

- [Estimating Generalized Linear Models for Count Data with rstanarm](#)
- [Introduction to Bayesian \(geo\)-statistical modeling](#) (slideshow)
- [Building a Multilevel Model in BRMS Tutorial](#) (Smeets & van de Schoot)
- [Quantecol: Marginalising discrete variables in ecological models](#) (Hollanders, 2025)
- [8.6 - Bayesian estimation of generalised linear models | Modern Statistics with R](#)
- [Recommendations for visual predictive checks in a Bayesian workflow](#) (Säilynoja et al.)
- Data visualization
 - [Data viz \(ggplot\) cheat sheet](#)
 - [R Graphics Cookbook](#)
 - [Royal Statistical Society Best Practices for Data Visualisation](#)
 - Color palettes
 - [R Color Palette Finder](#) includes color blindness testing
 - [R Color palette picker](#)
 - [EmilHvitfeldt/r-color-palettes: Comprehensive list of color palettes available in R](#)
 - [Canva color palettes](#)
 - [Other color palettes](#)
 - [Designing monochrome data visualisations](#) (Rennie, 2025)
 - [Adjust endpoints of viridis and scico color palettes](#)
 - [ggplot2: Elegant Graphics for Data Analysis \(3e\)](#)
 - [Top 50 ggplot2 Visualization Types](#)
 - [ALL ggplot legend options](#)
 - [Principles of Effective Data Visualization](#)
 - [Adding social media icons to charts with {ggplot2}](#) (Rennie)
 - [Dealing with long labels](#) (Heiss)
 - [How to use a histogram as a legend in {ggplot2}](#) (Heiss)
 - [The guide to gradients in R and ggplot2](#) (Goldie)
 - [Visualize as You Randomize: Design-Based Statistical Graphs for Randomized Experiments](#) (Coppock, 2020)
 - Tidy Tuesday & other inspiration
 - [Official repo for the #tidytuesday project](#)
 - [Hanukkah of Data](#)
 - Tables
 - [flextable book](#) (Gohel, 2024)
- Ecology
 - Courses
 - [Theory-driven Analysis of Ecological Data](#) (GitHub repo)
 - [Functional Rarity and Diversity in Ecology](#)
 - [Key Concepts in Ecology](#) from BES
 - [Analysis of Ecological and Environmental Data](#) (UWashington QERM 514)
 - [Best Practices in Environmental Data Science](#) (UWashington FISH 549)
 - [Data Science for Ecologists & Environmental Scientists](#)
 - [Dynamic State Variable Models in Ecology \(book\)](#)
 - [Diversity-Interactions models \(species diversity\)](#)

- Other courses
 - [Parameter estimation for nonlinear stochastic dynamical systems](#) (McMaster Stat 744)
 - [Biol 607/617: Biostatistics and Experimental Design](#) (Jarrett Byrnes)
 - [Biol 609: Advanced Data Analysis for Biology](#) (Jarrett Byrnes)
 - [Resources, Blogs, and More !](#)
 - [Advanced Statistical Analysis & Design II](#) (Shane Mueller, Michigan Tech)
 - [Advanced Biological Statistics](#) (University of Oregon BIO 610, Ralph and Cresko)
 - [Online Dynamic Energy Budget course](#)
 - [Harvard CS50x 2025](#)
 - [Likelihood-based inference for dynamic systems](#) (Edward Ionides, UMich)
- Quarto & R Markdown
 - Quarto
 - <https://posit.co/blog/create-a-quarto-document-in-positron/>
 - [Awesome Quarto](#)
 - [Quarto template to create thesis documents](#) (Monash University)
 - [A Quarto + Typst Template for Academic Manuscripts](#)
 - [Making Pretty PDFs with Quarto](#) (Kazuharu Yanagimoto)
 - [Quarto poster](#)
 - [Creating your personal website using Quarto](#)
 - [Closeread](#), a Quarto format that enables scrollytelling features for html documents
 - [Making pretty note boxes | Desirée De Leon](#)
 - [Quarto Manuscripts](#)
 - [Gallery – Quarto](#)
 - https://blog.djnavarro.net/posts/2025-07-05_quarto-syntax-from-r/
 - [Quarto Templates](#) (Christopher Kenny)
 - [R Markdown Cheat Sheet](#) (and another [reference guide](#))
 - [R Markdown cookbook](#)
 - R Markdown [formats](#)/templates
 - [LaTeX Journal Article Templates for R Markdown](#) ([rticles](#))
 - [Rmarkdown + Bookdown templates for Reproducible Data Analyses](#)
 - [Section 1 Markdown syntax | Reproducible Research in R](#)
 - [Bootstrap Icons](#)
 - LaTeX
 - [TableGenerator \(export to LaTeX, etc.\)](#)
 - [Detexify](#) (draw symbol → LaTeX code)
 - [LaTeX templates](#)
 - [A Latex Template for \(Quantitative\) Ecology Manuscripts](#)
 - [All the Ways to Programmatically Edit or Parse R Markdown / Quarto Documents](#)
- Other free online books
 - [Ocean 285: Physics Across Oceanography](#)
 - [Fish, Fishing, and Conservation](#)
 - [Nature - Statistics for Biologists](#)

- [Supervised Machine Learning for Text Analysis in R](#)
- [Exploring Complex Survey Data Analysis Using R](#) (Zimmer et al., 2024)
- [Marine Mammal Acoustics in a Noisy Ocean](#)
- [Applications of PACE hyperspectral ocean color data for aquaculture and fisheries management](#)
- Time series and forecasting
 - [Using R for Time Series Analysis](#)
 - Steve Midway's course material for [Time Series Models in Ecology](#)
 - [Forecasting: Principles and Practice](#) (with R) - ts/zoo objects
 - [Forecasting: Principles and Practice \(3rd ed\)](#) - with tsibble objects
 - [Applied Time Series Analysis for Fisheries & Environmental Sciences](#) (with R) - book
 - [Course material homepage](#)
 - [Introduction to Time Series Analysis and Forecasting in R](#) (Tejendra Pratap Singh)
 - [Fisheries Catch Forecasting](#)
 - [A guide to state-space modeling of ecological time series](#) (article)
 - [Time Series Analysis With R](#) (Selva Prabhakaran)
 - [Dynamic generalized additive models \(DGAMs\) for forecasting discrete ecological time series](#) (Clark 2022, package [mvgam](#))
 - [State-Space models in the mvgam package](#)
 - [State-Space Vector \(Multivariate\) Autoregressions in mvgam](#)
 - [Seminar slides](#)
 - [Great blog post about how to use mvgam](#)
 - [Answering some 'Forecasting with GAMs in R' questions](#)
 - [Incorporating time-varying seasonality in forecast models](#)
 - [imputeTS package cheatsheet](#)
 - [Time series graphics using feasts](#)
 - [10.1 Repeated Measures and Longitudinal Data](#)
 - [Repeated Measures Analysis With R](#)
 - [weecology YouTube channel](#) (Morgan Ernest, Ethan White)
 - [EFI Zotero library](#) (>500 papers)
- Spatial
 - [Spatial Data Science With Applications in R](#) (r-spatial, Pebesma & Bivand, 2023), great
 - [An Introduction to Spatial Data Analysis and Statistics: A Course in R](#) (Paez)
 - [rspatialdata](#)
 - [Hands-On Spatial Data Science with R](#)
 - [Spatial Statistics for Data Science: Theory and Practice with R](#) (Moraga)
 - [Geospatial Data: Modeling and Visualization with R-INLA & Shiny](#) (Moraga)
 - [Intro to GIS and Spatial Analysis](#) (Gimond)
 - [Spatial Sampling with R](#) (Brus, 2023) - good general reference for sampling
 - [Intro to Geospatial Raster and Vector Data with R for COBALT](#)
 - [All things R Spatial](#)
 - [Geocomputation with R](#)
 - [Spatial machine learning with R: caret, tidymodels, and mlr3](#)

- [Earth Data Science \(GIS, R, Python, remote sensing, etc.\)](#)
- [Geospatial chapters](#) of Modern Data Science with R
- [Spatial regression](#) (and [regression of areal data](#))
- [Tutorial - Dealing with spatial autocorrelation](#)
- [30DayMapChallenge](#) & [Mapping resources - 30DayMapChallenge](#)
- [Visualizing Information and Spatial Analysis with ggplot2 Extensions](#) (VISAGE, Dahiya)
- R package cheatsheets
 - [sf](#)
 - [leaflet](#)
 - [mapsf](#)
- Spatiotemporal
 - [Handling and Analyzing Spatio-Temporal Data](#) (CRAN task view)
 - [Spatio-Temporal Statistics with R](#) (book, Wikle et al., 2019 - amazing)
 - [Non-Parametric Analysis of Spatial and Spatio-Temporal Point Patterns](#)
- GAMs
 - [Generalized Additive Models](#) M. Clark book
 - [GAMM analysis of time series data](#)
 - [Extrapolating with B splines and GAMs](#)
 - [Using random effects in GAMs with mgcv](#)
 - [Hierarchical GAMs in ecology: an introduction with mgcv](#)
 - [Generalized Additive Models: An Introduction with R](#) (course)
 - [3 - Spatial GAMs and Interactions](#)
 - [Workshop: Generalized additive models in R](#)
 - [Materials for the "Generalized Additive Models in R" workshop](#)
 - [How to interpret and report nonlinear effects from GAMs](#)
 - [Marginal Effects Zoo: Interactions, polynomials, and splines](#)
 - [Generalized Additive Models \(GAMs\) for Meta-Regression using brms](#)
- Building R packages
 - [R Packages \(2e\)](#)
 - [BIOS² Education resources - Building R packages](#)
 - [rOpenSci Packages: Development, Maintenance, and Peer Review](#)
 - [Project Structure | The Strategy Unit](#)
 - [CRAN Cookbook: solutions to common CRAN submission issues](#)
 - [Maëlle Salmon's blog](#)
 - CRAN Task View [proposal](#) for "Package Development and Maintenance"
 - <https://github.com/ThinkR-open/prepare-for-cran>
- Genomics, phylogenetics, etc.
 - [Population genetics and genomics in R](#)
 - [Population Genetics in R](#)
 - [Microbiome for beginners](#)
 - [Data Integration, Manipulation & Visualization of Phylogenetic Trees](#) (book, for R)
 - [The Mathematics of Phylogenetics](#) (textbook by Allman and Rhodes)

- [Computational Genomics with R](#) (book)
- [Genomic Data Visualization](#) (course, in R)
- [Phylogenetic Methods](#) (course, Brian O'Meara)
 - <https://github.com/simjoly/CourseComparativeMethods>
- Python & other programming
 - [An introduction to Python for R users – Occasional Divergences](#) (Marc Dotson)
 - [An introduction to Python for R Users](#) (Rebecca Barter)
 - [Introduction to Julia for R users – Nicola Rennie](#)
 - [DataCamp \(data science/python/etc.\)](#)
 - [CodinGame](#) tons of different languages
 - [Python Data Science Handbook](#)
 - [BRITE Python Workshop Docs](#)
 - [Kaggle](#)
 - [Data Science Resource Repository \(DSRR\)](#)
 - [Michigan ADRC Data Sharing Hub - Command Line Tools resource list](#)
- Videos
 - [Quantitative methods for population dynamics](#)
 - [Ecological Forecasting Initiative- Statistical Methods Seminar Series](#)
 - [Center for the Advancement of Population Assessment Methodology](#) workshops
 - [NMFS R User Group Lightning Talks: Open Science Work in R](#)
- Strings & regular expressions
 - R for Data Science 2e Ch. [15 - Regular expressions](#)
 - <https://rstudio.github.io/cheatsheets/regex.pdf>
 - <https://regexlearn.com/cheatsheet> (<https://regexlearn.com/>)
 - [String manipulation cheat sheet](#)
 - [Regex101](#)
 - [RegExr](#)
 - [RegexOne](#)
- Text analysis
 - [Text Mining with R](#) (free book, Silge & Robinson)
 - [CRAN Task View: Natural Language Processing](#)
 - [Automated Content Analysis with R](#) (Puschmann & Haim)
 - [Supervised Machine Learning for Text Analysis in R](#) (free book, Hvitfeldt & Silge, 2022)
- Other
 - [Mixture Modeling: Mixture of Regressions](#)
 - [A companion website for the mclust book](#)
 - [TMB training](#) (beginner & intermediate TMB courses for use within R, from NMFS)
 - [Fun with Positron | Andrew Heiss](#)

Science Tools

- [GrantForward](#)
- [AnyStyle](#)

List of R/Modeling Resources

developed by Ruby Krasnow (rubykrasnow@gmail.com) - reach out with questions or comments!

- [Natl. Center for Biotech Info \(data, analysis tools, etc.\)](#)
 - [All Resources](#)
- [BioRender \(create science figures\)](#)
- <https://inkscape.org/>
- [Kroki](#): Creates diagrams from textual descriptions
- [Academic Phrasebank](#)
- [Tools for Academic Research \(collection\)](#)
- [Scolary \(collection of scientific tools\)](#)
- [Humphries Lab manual](#) (good info about publishing manuscripts)
- [GitHub Awesome Research Tools](#) (collection)
- [GitHub Awesome OpenSource Resources](#) (collection)
- [Earth Science Women's Network Online Resource Center](#)
- [ESIL Data Library](#)
- Note-taking: [Joplin](#), [notion.so](#), Obsidian
- Free images & icons
 - [PhyloPic](#) (silhouette images)
 - [University of Washington Freshwater and Marine Image Bank](#)
 - [Bootstrap icons](#)
 - [Font Awesome](#) icons
 - [Picryl](#)
 - [The Noun Project](#)
 - [NIH BioArt](#)
 - [SciDraw](#)
- Literature searching, reviews, & citation managers
 - [ConnectedPapers](#)
 - [Literature Searching - NOAA Research Services](#)
 - [Citation Chaser](#)
 - [SWIFT-Review](#)
 - [SciWheel](#)