



Randall Pruim

PH.D.

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Education

University of Wisconsin

PhD (MATHEMATICS)

Madison, WI

1995

- Thesis: Weakly hard languages and Kuratowski-Ulam theorems for resource-bounded category

Calvin University

BA (MATHEMATICS & GERMAN)

Grand Rapids, MI

1988

Experience

Calvin University

PROFESSOR

2011 –

University of Michigan

VISITING ASSOCIATE PROFESSOR

2004 – 2005

Calvin University

ASSOCIATE PROFESSOR

2003 – 2011

Calvin University

ASSISTANT PROFESSOR

1998 – 2003

Boston University

VISITOR AND LECTURER

1996 – 1998

Providence College

SPECIAL LECTURER

1995 – 1996

Calvin University

VISITING ASSISTANT PROFESSOR

1995

Awards and Grants

NSF S-STEM: Expanding Computation for Interdisciplinary Science

\$600 K

PI WITH CO-PIS JOEL ADAMS, DAVID BENSON, SERITA NELESEN, RANDALL DEJONG

2012–2016

- This grant funded scholarships of up to \$8000 annually and other support for Calvin students studying science and computation.

NSF TUES: Leveraging Laboratory Activities to Achieve Educational Reform

\$200 K

co-PI WITH DAVID KOETJE (PI), AMY WILSTERMANN, HERBERT FYNEVER, AND RANDALL VAN DRAGT

2012–15

- This grant supported work to produce new laboratory materials for the introductory biology sequence.

NSF ARI-R2: Integrated Science Research Experimental Laboratory

\$951 K

co-PI WITH DAVID BENSON (PI), DAVID DEHEER, MATTHEW WALHOUT, AND CHAD TATKO

2010–11

- This NSF grant funded the remodeling of the laboratory space on the ground level of the Science Building.

NSF S-STEM: Computation for Interdisciplinary Science

\$581 K

PI WITH CO-PIS JOEL ADAMS, DAVID DEHEER, DAVID KOETJE, AND KIETH VANDER LINDEN

2009–13

- This grant funded scholarships of up to \$8000 annually to Calvin students studying science and computation.

NSF CCLI, Phase II: Building a Community around Modeling, Statistics, Computation, and Calculus

\$275 K

co-PI WITH DANIEL KAPLAN (PI), NICHOLAS HORTON, AND ERIC MARLAND

2009–12

- This grant funded an initiative called Project MOSAIC. <http://mosaic-web.org/>

Howard Hughes Medical Institute grant	\$1.1 M
CO-PI AND DIRECTOR OF INTEGRATED SCIENCE RESEARCH INSTITUTE	2008-12
• This granted funded several initiatives across STEM at Calvin	
Fulbright scholar at the Universität Heidelberg	1990-91
GRADUATE STUDENT	
• I spent my third year of graduate school in Heidelberg	

Publications

- Pruim, R., Gîrjău, M.-C., & Horton, N. J. (2022). *The importance of good coding practices for data scientists*. <https://doi.org/10.48550/ARXIV.2210.03991>. submitted to *Harvard Data Science Review*.
- Gould, R., Peng, R. D., Kreuter, F., Pruim, R., Witmer, J., & Cobb, G. W. (2018). Challenge to the established curriculum: A collection of reflections. In *International handbook of research in statistics education* (pp. 415–432). https://doi.org/https://doi.org/10.1007/978-3-319-66195-7_13
- Pruim, R. (2018). *Foundations and applications of statistics: An introduction using R* (2nd ed.). Available at <https://www.ams.org/publications/authors/books/postpub/amstext-28>
- Heun, M. K., Santos, J., Brockway, P. E., Pruim, R. J., Domingos, T., & Sakai, M. (2017). From theory to econometrics to energy policy: Cautionary tales for policymaking using aggregate production functions. *Energies*, 10(203), 1–44. <https://doi.org/10.3390/en10020203>
- Heun, M., Santos, J., Brockway, P. E., Pruim, R., Domingos, T., & Sakai, M. (2017). *Empirical datasets for energies journal article'from theory to econometrics to energy policy: Cautionary tales for policymaking using aggregate production functions'*. University of Leeds; University of Leeds.
- Pruim, R., Kaplan, D. T., & Horton, N. J. (2017). The mosaic package: Helping students to think with data using R. *R Journal*, 9(1), 77. Available at <https://journal.r-project.org/articles/RJ-2017-024/>
- Pruim, R. (2015). How statistics teaching has changed over the last 10 years. *AMSTAT News: The Membership Magazine of the American Statistical Association*, (459), 25–27.
- Pruim, R. (2015). Review of Foundational and Applied Statistics for Biologists Using R by Ken A. Aho. *The American Statistician*, 69(3), 245–246. Available at <http://www.jstor.org/stable/24592059>
- Adams, J. C., & Pruim, R. J. (2012). Computing for STEM majors: Enhancing non CS majors' computing skills. *Proceedings of the 43rd ACM technical symposium on computer science education*, 457–462.
- Dornbos, D. L., & Pruim, R. (2012). Moist Soils Reduce the Effectiveness of Glyphosate on Cut Stumps of Buckthorn. *Natural Areas Journal*, 32(3), 240–246. <https://doi.org/10.3375/043.032.0302>
- Pruim, R. (2012). Randomness and God's governance. In D. Haarsma & S. Hoezee (Eds.), *Delight in creation*. Available at https://ministrytheorem.calvinseminary.edu/wp-content/uploads/2016/06/9_pruim.pdf
- Pruim, R. (2011). *Foundations and applications of statistics: An introduction using R*. Available at <https://www.ams.org/publications/authors/books/postpub/amstext-13>
- Pruim, R. J., Welch, R. P., Sanna, S., Teslovich, T. M., Chines, P. S., Gliedt, T. P., ... Willer, C. J. (2010). LocusZoom: Regional visualization of genome-wide association scan results. *Bioinformatics*, 26(18), 2336–2337.
- Adams, J., Matheson, S., & Pruim, R. (2008). BlastEd: Integrating biology and computation. *J. Comput. Sci. In Coll.*, 24(1), 47–54.
- Scott, L. J., Mohlke, K. L., Bonnycastle, L. L., Willer, C. J., Li, Y., Duren, W. L., ... Boehnke, M. (2007). A genome-wide association study of type 2 diabetes in Finns detects multiple susceptibility variants. *Science*, 2649–2653. <https://doi.org/10.1126/science.1142382>
- Willer, C. J., Scott, L. J., Bonnycastle, L. L., Jackson, A. U., Chines, P., Pruim, R., ... Boehnke, M. (2006). Tag SNP selection for finnish individuals based on the CEPH utah HapMap database. *Genetic Epidemiology*, 30(2), 180–190. <https://doi.org/http://dx.doi.org/10.1002/gepi.20131>
- Wegener, I. (2005). *Complexity theory: Exploring the limits of efficient algorithms* (p. xii+308). Berlin: Springer-Verlag. Translated from the German by Randall Pruim.

- Pollett, C., & Pruim, R. (2002). Strengths and weaknesses of LH arithmetic. *MLQ Math. Log. Q.*, 48(2), 221–243.
- Fenner, S., Homer, S., Pruim, R., & Schaefer, M. (2001). Hyper-polynomial hierarchies and the polynomial jump. *Theoret. Comput. Sci.*, 262(1-2), 241–256.
- Green, F., & Pruim, R. (2001). Relativized separation of EQP from P^NP . *Inform. Process. Lett.*, 80(5), 257–260. [https://doi.org/10.1016/S0020-0190\(01\)00176-4](https://doi.org/10.1016/S0020-0190(01)00176-4)
- Pruim, R. (2000). Review of Hilbert's Tenth Problem by Yittri Matiyasevich. *SIGACT News*, 31(1), 4. <https://doi.org/http://doi.acm.org/10.1145/346048.568465>
- Fenner, S., Green, F., Homer, S., & Pruim, R. (1999). Determining acceptance possibility for a quantum computation is hard for the polynomial hierarchy. *R. Soc. Lond. Proc. Ser. A Math. Phys. Eng. Sci.*, 455(1991), 3953–3966.
- Fenner, S., Green, F., Homer, S., & Pruim, R. (1998). Quantum NP is hard for PH. In *Theoretical computer science (Prato, 1998)* (pp. 241–252). World Sci. Publ., River Edge, NJ.
- Schöning, U., & Pruim, R. (1998). *Gems of theoretical computer science* (p. x+320). Berlin: Springer-Verlag. *Translated from the 1995 German original and revised by Pruim.*
- Fenner, S., Homer, S., Pruim, R., & Schaefer, M. (1997). Hyper-polynomial hierarchies and the NP-jump. In *Proceedings of the twelfth Annual IEEE Conference on Computational Complexity (Ulm, 1997)* (pp. 102–110). Washington, DC, USA: IEEE Computer Soc., Los Alamitos, CA.
- Joseph, D., Pruim, R., & Young, P. (1994). Collapsing degrees in subexponential time. *Proceedings of IEEE 9th annual conference on structure in complexity theory*, 367–382. IEEE.
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- ## Invited and Conference Presentations
- Three-course dinner or Thanksgiving feast? Putting the pieces together in a modern math/stat sequence.* (2022). Invited Paper, Joint Statistical Meetings.
- GAISE for majors.* (2020). Invited Paper, Joint Statistical Meetings.
- Clean water for liberia.* (2019). Biennial Meeting of the Association of Christians in the Mathematical Sciences. *With S DeRuiter and M Bone.*
- Domino arithmetic.* (2019). MathPath Plenary Talk, Grand Valley State University.
- Less volume, more creativity: R for busy humans.* (2019). Biennial Meeting of the Association of Christians in the Mathematical Sciences.
- Mixing D3 and R.* (2019). Big Data Ignite.
- Creating R packages with RStudio and GitHub.* (2018). West Michigan R Users Group.
- ggformula: A less volume, more creativity approach to data viz in R.* (2018). Electronic Conference on Teaching Statistics.
- Less volume, more creativity: Picking your R (starter) toolkit.* (2018). Big Data Ignite.
- Less volume, more creativity: An introduction to the mosaic suite of R packages.* (2015). University of Auckland.
- A mathematician teaches statistics: Tales from the front lines.* (2013). Convener of an invited panel at MathFest.
- How a little linear algebra can go a long way in the Math Stat course.* (2013). Joint Mathematics Meetings.
- The other intro course: Combining foundations, applications, and computation in the Math Stat course.* (2013). Joint Mathematics Meetings.
- Toward big data in teaching statistics.* (2013). Invited panelist at 2013 Joint Statistical Meetings.
- Using R in intro stats: Less volume, more creativity.* (2013). Break out session at 2013 US Conference on Teaching Statistics.
- A mosaic sampler.* (2011). UseR! Conference.
- Alumni panel.* (2011). SC11 International Conference for High Performance Computing, Networking, Storage; Analysis Education Program.

Golf balls in the yard: Using simulation to teach hypothesis testing. (2011). Available at <http://www.causeweb.org/webinar/activity/2011-01/>

Madly rating and ranking. (2011). Annual Meeting of the Michigan Section of the Mathematical Association of America.

Madly rating and ranking. (2011).

Teaching statistics using R. (2011). Roundtable at the Joint Statistical Meetings.

Technology changes things. (2011). Michigan NExT invited talk.

Toward a MOSAIC R package for calculus and statistics. (2011). Project MOSAIC M-cast (webinar).

Can sage replace maple and mathematica? (2010). Michigan Section MAA.

Domino arithmetic. (2010). Aquinas College Mathematics Colloquium.

Golf balls in the yard: Using simulation to teach hypothesis testing. (2010). Available at <http://www.causeweb.org/wiki/mosaic/index.php/Mcast-schedule>

Math and bio in 2010. (2010). invited panel presentation at MAA MathFest.

What is sage and what should i use it for? (2010). Available at <http://mosaic-web.org/KickOff/Presentations/sagetalk.pdf>. Part of the Project MOSAIC Kick-Off Workshop.

What should a modern mathematical statistics course look like? (2010). Michigan Section MAA.

"BlastEd: An exemplar for interdisciplinary learning and curriculum development. (2008). HHMI Quantitative Biology Workshop.

Calculus the way it might have been: An introduction to non-standard analysis. (2008). Central Michigan University Mathematics Colloquium.

Visualization of data using R. (2008). invited presentation at the University of Michigan Genome Science Training Program annual retreat.

Calculus the way it might have been: An introduction to non-standard analysis. (2007). Upper Peninsula Section Meeting (Michigan MAA).

Calculus the way it might have been: An introduction to non-standard analysis. (2007). Hope College Mathematics Colloquium.

Some things quantum computers can and can't do. (2004). University of Ulm Theoretical Computer Science Seminar.

From paradox to primes: An introduction to kolmogorov complexity. (2003). Kalamazoo College Mathematics Colloquium.

A few of my favorite (technological) things. (2002). Michigan NExT Symposium.

Math on the web. (2002). Christian Educators Association.

Statistical top n lists. (2002). Christian Educators Association.

From paradox to primes: An introduction to kolmogorov complexity. (2001). Hope College Mathematics Colloquium.

Using the internet effectively to teach mathematics: Advice, recommendations, examples, and things you should know. (2001). Michigan NExT Symposium.

Web resources for teaching statistics. (2000). Mathematics-in-Action Conference.

How to multiply. (1999). Hope College Mathematics Colloquium.

Mastermind, super-mastermind, and super-duper mastermind: Strategies for humans and computers. (1998). Hudson River Undergraduate Mathematics Conference.

How to exchange and share presents. (1996). Pi Mu Epsilon Mathematics Honor Society invited address, Providence College.

What is computational complexity theory? (1996). Pi Mu Epsilon Mathematics Honor Society; MAT Subfields of Mathematics Series invited address, Providence College.

Mathematics for liberal arts courses. (1995). Biennial Meeting of the Association for Christians in the Mathematical Sciences. *Panelist*.

Collapsing degrees in sub-exponential time. (1994). Structure in Complexity Theory Conference, Amsterdam. *July 1994.*

Workshops

Shiny from start to finish. (2020). 2020 RStudio::conf. Assisted in workshop led by D Kaplan. January 2022.

MAA minicourse: Keep teaching statistics using R. (2019). Available at <https://rpruim.github.io/JMM2019/>. With Shonda Kuiper. January 2019.

MAA minicourse: Start teaching statistics using R. (2019). Available at <https://rpruim.github.io/JMM2019/>. With Shonda Kuiper. January 2019.

North Park faculty development workshop: R for data science. (2019). Available at <https://rpruim.github.io/NorthPark2019/>. A 3-day workshop for faculty. July 2010.

StatPREP workshops. (2019). Available at <https://statprep-workshops-2019.netlify.app/>. These 2-day workshops were funded by a grant from the National Science Foundation. Each workshop had 3–5 presenters.

Grinnell data science workshop for faculty. (2018). Grinnell College. With D Kaplan. June 2018.

MAA minicourse: Teaching statistics using R and RStudio. (2018). Joint Mathematics Meetings. January 2018.

Using R in clinical practice and research. (2018). City of Hope Comprehensive Cancer Center. 1-day workshop for clinicians and researchers. January 2018.

Computation and Visualization Consortium Faculty Workshops. (2017). Available at <https://cvc-workshops.netlify.app/>. These week-long annual workshops were funded by a grant from the Howard Hughes Medical Institute. Each workshop had 2–4 presenters.

MAA minicourse: Teaching statistics with R and RStudio. (2017). Joint Mathematics Meetings. With D Kaplan.

Tidyverse data wrangling workshop. (2017). Big Data Ignite. October 2017.

Shiny workshop: Creating interactive web applications in R. (2016). Big Data Ignite. October 2016.

R day workshop. (2015). Strata + Hadoop World NYC. Assisted in a workshop led by G Grolemund, Y Xie, and N Stephens. September 2015.

Functions, parameters, and fitting for teaching calculus. (2013). 1-day workshop prior to Joint Mathematics Meetings, January 2013.

Modeling in calculus: Early and often. (2013). Caldwell, ID. MAA PREP Workshop. With D Kaplan, K-D Crisman, E Marland. July 2013.

Teaching statistics with R. (2013). 3-day Workshop prior to 2013 US Conference on Teaching Statistics. With D Kaplan and N Horton. May 2013.

Modeling in calculus: Early and often. (2012). Calvin College. 1-week MAA PREP Workshop, July 2012. With D Kaplan, E Marland, K-D Crisman, and N Horton.

Teaching modeling in calculus. (2012). 1-day Workshop prior to Joint Mathematics Meetings. With D Kaplan, E Marland, K-D Crisman, and N Horton. January 2012.

Teaching statistics using R. (2011). US Conference on Teaching Statistics. 3-day Workshop. With D Kaplan and N Horton. May 2011.

Using R for undergraduate research in statistical genetics. (2010). Hope College. An afternoon workshop for faculty and students. June 2010.

R dump. (2008). National Institutes of Health. A two-day workshop on using R for researchers at the National Institutes of Health.

RPackages Available on CRAN

mosaic (1.8.4.2): *Project MOSAIC Statistics and Mathematics Teaching Utilities* – Data sets and utilities from Project MOSAIC (<http://www.mosaic-web.org>) used to teach mathematics, statistics, computation and modeling. Funded by the NSF, Project MOSAIC is a community of educators working to tie together aspects of quantitative work that students in science, technology, engineering and mathematics will need in their professional lives, but which are usually taught in isolation, if at all. Role: author/maintainer. Last update: 2022.

mosaicCore (0.9.2.1): *Common Utilities for Other MOSAIC-Family Packages* – Common utilities used in other MOSAIC-family packages are collected here. Role: author/maintainer. Last update: 2022.

ggformula (0.10.2): *Formula Interface to the Grammar of Graphics* – Provides a formula interface to ‘ggplot2’ graphics. Role: author/maintainer. Last update: 2022.

mosaicData (0.20.3): *Project MOSAIC Data Sets* – Data sets from Project MOSAIC (<http://www.mosaic-web.org>) used to teach mathematics, statistics, computation and modeling. Funded by the NSF, Project MOSAIC is a community of educators working to tie together aspects of quantitative work that students in science, technology, engineering and mathematics will need in their professional lives, but which are usually taught in isolation, if at all. Role: author/maintainer. Last update: 2022.

NHANES (2.1.0): *Data from the US National Health and Nutrition Examination Study* – Body Shape and related measurements from the US National Health and Nutrition Examination Survey (NHANES, 1999-2004). See <http://www.cdc.gov/nchs/nhanes.htm> for details. Role: author/maintainer. Last update: 2015.

abd (0.2.8): *The Analysis of Biological Data* – The abd package contains data sets and sample code for The Analysis of Biological Data by Michael Whitlock and Dolph Schluter (2009; Roberts & Company Publishers). Role: author. Last update: 2015.

mosaicCalc (0.6.0): *R-Language Based Calculus Operations for Teaching* – Software to support the introductory MOSAIC Calculus textbook <https://www.mosaic-web.org/MOSAIC-Calculus/>, one of many data- and modeling-oriented educational resources developed by Project MOSAIC (<https://www.mosaic-web.org/>). Provides symbolic and numerical differentiation and integration, as well as support for applied linear algebra (for data science), and differential equations/dynamics. Includes grammar-of-graphics-based functions for drawing vector fields, trajectories, etc. The software is suitable for general use, but intended mainly for teaching calculus. Role: author. Last update: 2022.

mosaicModel (0.3.0): *An Interface to Statistical Modeling Independent of Model Architecture* – Provides functions for evaluating, displaying, and interpreting statistical models. The goal is to abstract the operations on models from the particular architecture of the model. For instance, calculating effect sizes rather than looking at coefficients. The package includes interfaces to both regression and classification architectures, including lm(), glm(), rlm() in ‘MASS’, random forests and recursive partitioning, k-nearest neighbors, linear and quadratic discriminant analysis, and models produced by the ‘caret’ package’s train(). It’s straightforward to add in other other model architectures. Role: author. Last update: 2017.

fastR2 (1.2.2): *Foundations and Applications of Statistics Using R (2nd Edition)* – Data sets and utilities to accompany the second edition of “Foundations and Applications of Statistics: an Introduction using R” (R Pruim, published by AMS, 2017), a text covering topics from probability and mathematical statistics at an advanced undergraduate level. R is integrated throughout, and access to all the R code in the book is provided via the snippet() function. Role: author/maintainer. Last update: 2022.

Lock5withR (1.2.2): *Datasets for ‘Statistics: Unlocking the Power of Data’* – Data sets and other utilities for ‘Statistics: Unlocking the Power of Data’ by Lock, Lock, Lock, Lock and Lock (ISBN : 978-0-470-60187-7, <http://lock5stat.com/>). Role: author/maintainer. Last update: 2015.

I also maintain several other packages, mostly for use in courses or for personal use (sometimes shared with colleagues) on GitHub. These include **CalvinBayes**, **CalvinData**, **leaflethex**, **daily**, **grading**, and **webwork**.

Some Teaching Materials Available Online

Below are a few examples of materials assembled for teaching that are available online.

Integrated ethics labs. (2022). Available at <https://integratedethicslabs.org/>. I’m the webmaster for this site which curates materials that can be used to teach ethics throughout the computer science, statistics, and data science

- curriculum. The materials are produced by the Integrated Ethics Team, led by Catherine Crockett and Lori Carter.
- Kaplan, D. T., & Pruim, R. (2022). *Statistical modeling: A fresh approach*. Available at <https://statistical-modeling.netlify.app/>. Modified version of a text by D Kaplan used in an online MBA course at Calvin University.
- Pruim, R. (2022). *Worksheets for discrete mathematics*. Available at <https://rpruim.github.io/m252/S22/from-class/>. These worksheets are used by students in groups of 3-4 throughout a semester-long course covering graph theory, counting and probability, and models of computation.
- Pruim, R. (2021). *Computational Bayesian statistics dope sheets*. Available at <https://rpruim.github.io/s341/S21/from-class/dope.html>. Notes, code examples, etc. related to a course on Bayesian methods. Includes links to other course materials.
- Pruim, R. (2021). *Statistics for the physical sciences and engineering*. Available at <https://rpruim.github.io/Engineering-Statistics/>. Text and Worksheets for a 2-hour course taken mainly by engineering students at Calvin University.
- Pruim, R. (2019). *(Re)Doing Bayesian Data Analysis*. Available at <https://rpruim.github.io/Kruschke-Notes/>. A companion to Doing Bayesian Data Analysis (Kruschke) demonstrating a different coding toolkit and style.
- Horton, N. J., Pruim, R., & Kaplan, D. T. (2015, November). *A student's guide to R* (1.2 ed.). Available at <https://github.com/ProjectMOSAIC/LittleBooks/blob/master/StudentGuide/Studentguide2015-11-09.pdf>
- Pruim, R., Horton, N. J., & Kaplan, D. T. (2015, November). *Start teaching with R* (1.1 ed.). Available at <https://github.com/ProjectMOSAIC/LittleBooks/blob/master/Starting/MOSAIC-StartTeaching.pdf>

Courses Taught

- At Calvin: CS 260 (Automata Theory) • CS 360 (Complexity and Computability) • Data 303 (Applied Modeling and Visualization) • Math 100 (Mathematics in the Contemporary World) • Math 132 (Calculus for Management, Life, and Social Sciences) • Math 156 (Discrete Mathematics for Computer Science) • Math 171 (Calculus I) • Math 172 (Calculus II) • Math 221 (The Real Number System and Methods for Elementary School Teachers) • Math 232 (Engineering Mathematics) • Math 251 (Discrete Mathematics I) • Math 252 (Discrete Mathematics II) • Math 312 (Logic, Computability, and Complexity) • Math 361 (Real Analysis) • Math 362 (Real Analysis II) • Math 381 (Mathematical Logic) • Stat 143 (Introduction to Probability and Statistics) • Stat 145 (Biostatistics) • Stat 241 (Engineering Statistics) • Stat 243 (Statistics) • Stat 341 (Computational Bayesian Statistics) • Stat 343 (Probability and Statistics) • Stat 343 (Mathematical Statistics) • Stat W82 (Visualize This! with D3) • MGMT 535 (Statistical Analysis)
- For The Institute for Statistics Education (statistics.com): Visualization in R with ggplot2
- At University of Michigan: Biostatistics (for graduate students in public health)
- At Boston University: Accelerated Intro Programming in C
- At Providence College: Mathematics for the Liberal Arts