

Supplementary Material

Table S1. PRIME Methods Details and Links to Software

Project ¹	Method Acronym	Method Title	Use when...	Software ²
BU/ Harvard	BKMR-CMA	Bayesian Kernel Machine Regression-Causal Mediation Analysis	Interest focuses on causal mediation analysis, and data exists on an environmental mixture, a continuous mediator, and a continuous outcome	https://github.com/kdevick/BKMR-CMA
BU/ Harvard	BMIM	Bayesian Multiple Index Model	Examining non-linear, non-additive relationships between exposures and outcome while reducing dimensionality via choice of indices	https://github.com/glenmcgee/BMIM
BU/ Harvard	DAG analysis	Use of causal methods for determining which exposures to include in a model	Modeling causal relationships between multiple exposures and a health outcome	No specific software
Columbia	BN2MF	Bayesian Non-parametric non-negative Matrix Factorization	Same as PCP	https://github.com/lizzyagibson/BN2MF
Columbia	PCP	Principal Component Pursuit	Aim is to identify exposure patterns in the population (either common sources or behaviors); preferably somewhat high-dimensional exposures for the process to be meaningful	https://github.com/Columbia-PRIME/pcpr https://github.com/Columbia-PRIME/PCPhelpers
Duke	BAG	Bag of DAGs	Modeling spatiotemporal data that may be large and have non-stationary or direction dependence (e.g., due to the impact of winds on air pollution dispersal)	https://github.com/jinbora0720/BAG
Duke	BMC	Bayesian Matrix Completion for hypothesis testing	1) Large missingness in data having multiple chemicals and multiple assay endpoints, and/or 2) Want to predict activity of a new (chemical, assay endpoint) pair, and/or 3) Dose-response shapes are irregular, and/or 4) Heteroscedastic signals are evident	https://github.com/jinbora0720/BMC
Duke	BS3FA	Bayesian partially supervised sparse and smooth factor analysis	1) Data has functional Y and numeric (continuous, binary, count) data X, 2) No supervising X data are available and smooth unsupervised factor analysis is desired, 3) Want to compute distance of chemicals relevant to toxicity, 4) Want to predict activity for a new chemical without dose-response information	https://github.com/niehs-prime/bs3fa
Duke	FIN	Factor analysis for interactions	1) Predictors are correlated and 2) Want to model pairwise/higher-order interactions of many predictors	https://github.com/niehs-prime/factor_interactions
Duke	GIF-SIS	Generalized infinite factor model	1) Want to fit a member of the large class of factorization/factor models and 2) Variables have relationships which are known a priori and should inform shrinkage behavior	https://github.com/lorenzo-schiavon/GIF_SIS
Duke	GL-GPs	Graph Laplacian based Gaussian Process	Interested in performing nonparametric regression on a domain that is highly restricted or nonlinear	https://github.com/wunan3/Diffusion-based-Gaussian-Process
Duke	GriPS	Computational improvements for Bayesian multivariate regression models based on latent meshed gaussian processes	Addressing how to efficiently solve the big-n problem for GPs when the number of outcomes is large	https://cran.r-project.org/package=meshed
Duke	MatchAlign	Resolving rotational ambiguity in matrix sampling	Interested in post-processing MCMC samples to allow inference on unidentifiable random matrices (e.g., factor loadings matrix)	https://github.com/poworoznek/infinitefactor

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Duke	MixSelect	Identifying main effects and interactions among exposures using Gaussian processes	1) Want to decompose an outcome into linear effects, interactions, and non-linear effects of the predictors, and 2) Have hierarchical variable selection on main effects and interactions	https://github.com/fedfer/MixSelect
Duke	MrGap	Manifold Reconstruction via Gaussian Process	1) Want to obtain an estimate of a low-dimensional manifold in the original high-dimensional observation space and 2) Data are noisy	https://github.com/wunan3/Manifold-reconstruction-via-Gaussian-processes
Duke	PFA	Perturbed factor analysis	A set of variables (e.g., chemical exposures) are expected to exhibit a similar covariance structure across multiple groups of observations (e.g., individuals from different demographic backgrounds) and the researcher would like to express that common structure via a set of shared factors	https://github.com/royarkaprava/Perturbed-factor-model
Duke	SPAMTREE	Spatial Multivariate Trees	Multiple gaussian outcomes, massive datasets (big n), some outcome measured at fewer input levels	https://cran.r-project.org/package=spamtree
MSSM/ Harvard	NLinteraction	Bayesian semiparametric regression with sparsity inducing priors	Have data on a continuous outcome and an environmental mixture, and interest focuses on interaction among exposures within a mixture, and the form of the multivariate exposure-response surface is potentially complex	https://github.com/jantonelli111/NLinteraction
MSSM/ Harvard	ACR	Acceptable Concentration Range model	Estimating points of departure from human data which may suggest data-driven uncertainty factors in risk assessments of single chemicals	NA
MSSM/ Harvard	Bayes Tree Pairs	Bayesian Regression Tree Pairs	Interest focuses on identifying critical windows of exposure, when data on multiple exposures measures with high temporal resolution (e.g., weekly during pregnancy) is available Relative to BKMR-DLM, is better for large datasets (e.g., large cohorts or administrative data)	https://github.com/danielmork/dlmtree
MSSM/ Harvard	BKMR-DLM	Bayesian Kernel Machine Regression-Distributed Lag Model	Interest focuses on identifying critical windows of exposure, when data on multiple exposures measured with high temporal resolution (e.g., weekly during pregnancy) is available Relative to Bayes Tree Pairs, is better for small to moderately sized datasets	https://github.com/niehs-prime/regimes
MSSM/ Harvard	CVEK	Cross-validated kernel ensemble	Interest focuses on sets of exposures, and how one set of exposures interacts with another set (e.g., Gene x Environment, Nutrition x Environment, Psychosocial Stress x Environment)	https://github.com/IrisTeng/CVEK-1
MSSM/ Harvard	Het-DLM	Heterogeneous distributed lag models	Interest focuses on fitting distributed lag models to identify critical windows of a time-varying exposure, and on identifying subpopulations that are disproportionately affected (e.g., exhibit stronger distributed lag effects)	https://github.com/danielmork/dlmtree
MSSM/ Harvard	LWQS	Lagged Weighted Quantile Sum (WQS) regression	Interest focuses on identifying critical windows of exposure and when the exposure temporal pattern differs across subjects	https://mran.microsoft.com/snapshot/2020-02-28/web/packages/gWQS/vignettes/gwqs-vignette.pdf https://cran.r-project.org/web/packages/lwqs/vignettes/lwqs-vignette.html
MSSM/ Harvard	Mult DLAG	Multiple exposure distributed lag models with variable selection	Data includes measures of multiple exposures measured with high temporal resolution over a developmental window, and interest focusses on critical windows	https://github.com/jantonelli111/BayesianDLAG

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			of exposure, and whether there are time-dependent interactions (does exposure of one pollutant early in time make an individual more susceptible to later exposures?)	https://github.com/evamtanner/Repeated_Holdout_WQS
MSSM/ Harvard	RH-WQS	Repeated holdout Weighted Quantile Sum (WQS) regression	Interest includes generalization of results by addressing variability of weights and association parameters	https://cran.r-project.org/web/packages/gWQS/vignettes/gwqs-vignette.html
MSSM/ Harvard	SGP-MPI	Scalable Gaussian Process regression via Median Posterior Inference	Interest lies in applying BKMR to massive data	NA
MSSM/ Harvard	DLMtree	Bayesian Treed Distributed Lag Models	Interest focuses on identifying a non-linear effect of a single exposure and the critical window during which this exposure operates (e.g., specific weeks during pregnancy) on a health outcome measured in the future	https://github.com/danielmork/dlmtree
ND/Rice	BDS	Bayesian Data Synthesis	A dataset cannot be shared publicly, but analyses on it are published The dataset may be comprised of mixed categorical, binary, count and continuous datatypes	https://github.com/drkowal
ND/Rice	BSSVI	Bayesian subset selection and variable importance for interpretable prediction and classification	The goal is to identify which variables jointly matter for prediction	https://github.com/drkowal/BayesSubsets
ND/Rice	BVSM	Bayesian variable selection for understanding mixtures in environmental exposures	The goal is to select variables and provide uncertainty quantification for a linear model	https://github.com/drkowal/BayesSubsets
ND/Rice	FOTP	Fast, optimal, and targeted predictions using parameterized decision analysis	The inferential target(s) can be represented as a functional of the data and the goal is either to predict the target(s) or interpret the model via the target(s)	https://github.com/drkowal
ND/Rice	SCC	Spatiotemporal case-crossover	Information is available for spatial regions (e.g., census blocks) over time and when the constant exposure assumption is not reasonable and spatial regions are irregular	https://github.com/kathysensor
ND/Rice	SiBAR	State Informed Background Removal	Interested in apportioning pollutants to local sources	https://github.com/bactkinson/SiBaR_Background_Removal_and_Quantification
UI Chicago	MVNimpute	Imputation of multivariate data by normal model	Preparing data for analysis	https://github.com/niehs-prime/mvnmimpute
UI Chicago	SPORM	Semi-Parametric Odds Ratio Model	Relationships among exposures, biologic intermediates and health outcomes are of major interest	https://github.com/hychen-uic/SPORM
UI Chicago	TEV	Estimation and inference on the explained variation parameter	Exposures are high-dimensional, and the effects of the exposures are weak and dense	https://github.com/hychen-uic

¹ Listed in alphabetical order, by institution. Project details available at NIH RePORTER: <https://reporter.nih.gov/>. Institutions: Columbia University Mailman School of Public Health, University of Illinois Chicago, Icahn School of Medicine at Mount Sinai, Harvard T.H. Chan School of Public Health, University of Notre Dame, Rice University, Boston University School of Public Health, Duke University.

² Updates to the software and possible changes to the links provided are expected over time, including links to packages not yet available. To retrieve the most up to date software, query GitHub <https://github.com/> using the method title or acronym.