

# Code for empirical Bayes small area prediction under a zero-inflated lognormal model with correlated random area effects

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## R package “saezero”

An R package called “saezero” has been developed for implementing the methodologies introduced in the paper. The package includes the following functions:

- `as.2pdata`: convert a data frame to a list customized for model fitting;
- `mleEBH`: obtain maximum likelihood estimates;
- `ebLBH`: obtain empirical Bayes small area predictor and associated one-step MSE estimator;
- `simLBH`: simulate responses given true model parameters and covariates.

The package is available and maintained at <https://github.com/XiaodanLyu/saezero>.

## How to execute the code

This folder contains R code for running both the simulation and the case study. Below is the file structure.

```
|-- README.pdf
|-- case_study
|   |-- data
|   |-- case_study.R
|   |-- case_study.pdf
|   `-- case_study.rmd
|-- simulation
|   |-- intermediate_results
|   |-- simulation.R
|   |-- simulation_results.Rmd
|   |-- simulation_results.pdf
|   `-- utility-functions.R
```

## Simulation

The file `utility-functions.R` contains helper functions for the simulation. The file `simulation.R` is the main function to be executed and outputs the `Rdata` files in the subfolder `intermediate_results` and the tables in the simulation section (Section 3) of the paper. The file `simulation_results.Rmd` produces `simulation_results.pdf` by putting together the R code and the outputs.

## Case study

Our R package “saezero” provides two data sets:

- `Xaux`: the auxiliary information for predicting cropland RUSLE2;
- `erosion`: the simulated data that mimics the real soil erosion data.

For detailed description of the two data sets, please refer to the package reference manual or run `?saezero::erosion` and `?saezero::Xaux` in R. The way we obtained the auxiliary information is given in the Section 4.1 of the paper. We cannot disclose the real CEAP soil erosion data. The files in this folder are intended to use the simulated data `erosion` and the real auxiliary information `Xaux` to reproduce similar tables and figures related to the CEAP data analysis (Section 4 of the paper). The file `case_study.rmd` produces `case_study.pdf` by combining the R code (`case_study.R`) and the outputs. The subfolder `data` contains some intermediate data files that would take a relatively long computing time to produce.

## Author information

Xiaodan Lyu is mainly responsible for writing the R code of this paper. Readers can email the author at [annielyu8@gmail.com](mailto:annielyu8@gmail.com) for any questions, comments and remarks on the code. Readers can also report bugs at <https://github.com/XiaodanLyu/zero-sae-bj-2020>.

## Computing Platform

For the parametric bootstrap part, 25 cores were used to speed up the computing process. The results shall be reproducible on a high performance computer using the same random seed and 25 cores. All the simulation code was run under the following configuration:

R version 3.5.0 (2018-04-23)

Platform: x86\_64-pc-linux-gnu (64-bit)

Running under: Red Hat Enterprise Linux

Matrix products: default

BLAS/LAPACK: /opt/rit/spack-app/linux-rhel7-x86\_64/gcc-4.8.5/  
openblas-0.3.3-vbnrrlvu244vbbzbjg45z4zudqv6sor3/  
lib/libopenblas\_haswell-r0.3.3.so

locale:

```
[1] LC_CTYPE=en_US.UTF-8      LC_NUMERIC=C
[3] LC_TIME=en_US.UTF-8      LC_COLLATE=en_US.UTF-8
[5] LC_MONETARY=en_US.UTF-8  LC_MESSAGES=en_US.UTF-8
[7] LC_PAPER=en_US.UTF-8     LC_NAME=C
[9] LC_ADDRESS=C             LC_TELEPHONE=C
[11] LC_MEASUREMENT=en_US.UTF-8 LC_IDENTIFICATION=C
```

attached base packages:

```
[1] stats      graphics  grDevices  utils      datasets  methods    base
```

other attached packages:

```
[1] lme4_1.1-21  Matrix_1.2-17 dplyr_0.7.5  saezero_0.1.0
```

loaded via a namespace (and not attached):

```
[1] Rcpp_0.12.16  lattice_0.20-38 assertthat_0.2.0 MASS_7.3-49
[5] grid_3.5.0    R6_2.2.2      nlme_3.1-137    magrittr_1.5
[9] rlang_0.2.2   minqa_1.2.4   nloptr_1.2.2    bindrcpp_0.2.2
[13] boot_1.3-20   splines_3.5.0 glue_1.2.0      purrr_0.2.4
[17] compiler_3.5.0 pkgconfig_2.0.1 bindr_0.1.1     tidyselect_0.2.3
[21] tibble_1.3.4
```