

The Natural Mathematics of Behaviour Analysis

Readme

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The code that is documented here was used to fit Catania's Operant Reserve (COR; Catania, 2005) to some single VI schedule data using a Markov Chain Monte Carlo scheme for Approximate Bayesian Computation (Marjoram, Molitor, Plagnol, & Tavaré, 2003). Here, we describe the contents of each file to facilitate navigation through the directory.

For the paper in which this analysis was presented, see Li, Hautus, and Elliffe (in press).

Libraries

We use the `CAB`, `data.table`, and `tmvtnorm` libraries for our analyses. The `CAB` package is available at <https://github.com/Don-Li/CAB>; it is now deprecated because I have changed the focus of the package. To parallelise the code, we used the `foreach` and `doParallel` packages. All the packages mentioned other than `CAB` are available on CRAN.

Data cleaning and data

- `data_cleaning.R`
 - Contains the code used for computing the necessary summary statistics for model fitting from the raw event records.
- `cost_function.R`
 - Contains three functions `cost_function`, `summary_statistics`, and `compute_cost2`.
 - `cost_function` computes the disparity between the observed and predicted summary statistics.
 - `summary_statistics` computes the values of the summary statistics.
 - `compute_cost2` calls the two above functions, tidies up the output and records the cost values.
- `behavioural_profile.RData`
 - Contains a `data.table` with the summary statistics for each subject.
- `COR_params.R`
 - Gets the model parameters. Saves a file `COR_params.RData`.
- `COR_params.RData`
 - Contains parameters for COR. Includes important things like the initial response rates. Also serves as a template for the entire parameter list, so it contains things like `reserve_level`, which get updated while the model runs.

Cost survey and outputs

- `S04_transition_survey.R`
 - Contains the code for doing the cost survey for subject S04.
 - Outputs the file `survey_results4.RData`, not included in git repo because of size.
 - Also periodically saves the intermediate results.
- `ABC_params.RData`
 - Computed from the outputs of the survey results. See Li, Hautus, and Elliffe (in press) for details.

COR functions

- `COR.do.R`
 - Contains two functions, `COR.do` and `simulate_COR2`
 - `COR.do` runs the model. Returns an event record.
 - `simulate_COR2` calls `COR.do` for a list of conditions (i.e. all the sessions) and returns a big event record.
- `COR_fx.R`
 - Contains three functions.
 - `DOR` for the delay of reinforcement gradient. Exponential.
 - `depletion` constant depletion function.
 - `rft_schedule` reinforcement schedule.
 - `emission` emission function.
 - These functions are in a list `COR_fx`.

ABC

- `ABC_mcmc.R`
 - Contains functions for doing ABC.
 - `do.mcmc` contains the main code for running the MCMC chain. Does all of the burn-in and proposal and threshold adjustments.
 - `do.accept_ratio` computes the acceptance ratio.
- `main_ABC.R`
 - Loads all the necessary functions and data and runs the ABC MCMC procedure.
 - Saves results in `fit_results.RData` with periodic saves for each subject.

Posterior evaluation

- `posterior_predictive.R`
 - Thins the MCMC chain and subsamples the posteriors.
 - Simulates COR at the posterior subsamples.

References

- Catania, A. C. (2005). The operant reserve: A computer simulation in (accelerated) real time. *Behavioural Processes*, 69(2), 257-278. <https://doi.org/10.1016/j.beproc.2005.02.009>
- Li, Hautus, & Elliffe (in press). The Natural Mathematics of Behaviour Analysis. *The Journal of the Experimental Analysis of Behaviour*.
- Marjoram, P., Molitor, J., Plagnol, V., & Tavaré, S. (2003). Markov chain Monte Carlo without likelihoods. *Proceedings of the National Academy of Sciences*, 100(26), 15324-15328. <https://doi.org/10.1073/pnas.0306899100>