Online Appendix

to accompany Pek, J., & Park, J. (2019). Complexities in power analysis: Quantifying uncertainties with a Bayesian-classical hybrid approach. *Psychological Methods*. Advance online publication. doi: 10.1037/met0000208

The Bayesian-classical hybrid approach to power analysis has been implemented in three files:

1. `functions.R` contains the functions for Monte Carlo (MC) power analysis that incorporate epistemic uncertainty of the unknown effect size and uncertainty due to model approximation.

2. `main.R` contains code to execute the functions in `functions.R` to compute power.

3. `sim.cpp` contains C++ functions to speed up computations.

The main function in `functions.R` is `model_uncertainty_power()`. The code was used to generate results for the example on lexical processing (e.g., see Yap & Seow, 2014), where $Q = 3$ competing null hypothesis significance tests (NHSTs) were considered. These three tests are the sign test, the t-test, and the likelihood ratio test (LRT). Recall that N denotes the sample size, S denotes the number of random draws from the design prior, $p(\theta)$, that quantifies epistemic uncertainty about the unknown effect size, and R denotes the number of MC samples of size N drawn from the population structure. The syntax of the function is

```
model_uncertainty_power(Ns, S, R)
```

where `Ns` is a vector of sample sizes for which power estimates are computed. The form of the population structure, specified under the Vale-Maurelli (1983) algorithm, and the model parameters (e.g., mean of the control group, μ_C, and the mean difference, μ_D) can be modified within the body of the function. Running this function will output a data frame containing three variables: (a) sample size `N`, (b) type of NHST, `tests`, and (c) estimated power `powers`.

The second file `main.R`, executes the functions in `functions.R` and generates summary information including the violin plots in Figure 3. `main.R` requires the following R packages to be installed: `ggplot2`, `dplyr`, and `Rcpp`.

To generate power estimates via the Bayesian-classical hybrid approach, all three files should be in the same folder. The user can modify input values such as `Ns`, `S`, and `R` in the section on `Simulation parameters`. The values of N are $(5, 10, \cdots, 60)$, $S = 100$, and $R = 100$ in `main.R`. To reproduce Figure 3, the user has to change the default values to $R = 10{,}000$ and $S = 1{,}000$, respectively. Increasing the values of S and R will increase the computational time needed to generate estimates of power.

When the code in `main.R` is executed, violin plots of the distribution of power estimates will be output as `.png` files in a new subfolder, `Figures`, which will be created within the working folder. There will be a total of $Q + 1$ image files; each NHST will have its own violin plots of power estimates, and violin plots of the test-averaged power estimates across the Q NHSTs are labeled `averaged.png`. Additionally, data frames containing the estimates of power will be saved in the working folder as `.csv` files for the user to generate other information (e.g., assurance or assurance levels).

References

Vale, C. D., & Maurelli, V. A. (1983). Simulating multivariate nonnormal distributions. *Psychometrika*, *48*(3), 465–471. doi: 10.1007/bf02293687

Yap, M. J., & Seow, C. S. (2014). The influence of emotion on lexical processing: Insights from rt distributional analysis. *Psychonomic Bulletin & Review*, *21*(2), 526–533. doi: 10.3758/s13423-013-0525-x