**Methods**

The shiny app was built using the shiny R package version 1.7.1 (Chang *et al.*, 2017), which allows development of interactive web based applications using R (version 4.2.0) (Team, 2013). The app is available at <https://r26dnk-grace-skinner.shinyapps.io/meta_meta_analysis/>, and the code is available at <https://github.com/gls21/CMEE_NHM_Project/tree/master/christina_mma/meta_meta_analysis>.

Describe basic set-up of shiny app – ui, server, global? e.g. navbarPage and fluid rows? Used flatly theme from bslib package. The user interface (ui) is coded with the fluidPage layout function, which includes fluidRows.

The app is split into tabs (intro, upload data, agricultural systems, xxxx, references). The intro tab introduces the app and its functionality. A table is displayed showing details of each paper used by the app, the number of agricultural systems studied, and total number of instances to give the user an idea of what the results are based on, and highlight any studies that may have a potentially influential effect. For example, the app uses 122 data points from the Morales.M paper while only 2 from Manik.Y and Hussain.M. If the user wants more details on a certain paper, they can select a paper to see a breakdown on the agricultural systems studied by that paper.

The upload data tab is available for when new meta-analyses are carried out. Once completed, their spreadsheet of results can be uploaded to the shiny app, where it will be stored in a onedrive? Checks are in place to ensure the file type is correct, and includes the correct information. Upon successful upload, all available data will be re-read into the app and the models will be re-run to produce updated results.

Upon start-up, the app runs a robust model using the rlmer function from the robustlmm package to analyse the effect of agricultural systems (i.e. Treatment) on log response ratio (LRR) of biodiversity. The model is fitted using the formula LRR ~ Treatment + (1|ID) + (1|Crop), with treatment a fixed effect and ID (i.e. the ID of the paper) and Crop as random effects. This models was originally fitted by Christina Raw as part of a meta-meta-analysis to assess biodiversity in different agricultural systems. The model is designed to compare all the agricultural systems to the reference conventional level into terms of log response ratio.

The results of this are displayed in the default tab of the agricultural systems tab. The app is designed so that the user can choose which results they are interested in and what to graphically investigate. The following options for user input are available: checkbox choice of agricultural systems to compare to the conventional reference level, drop-down list for choice of metric to plot (either log response ratio or percentage change), and radio buttons for the choice of whether or not to re-scale the x axis as different agricultural systems are selected. The default graph and table then reactively change in response to these selections.

See Christina’s thesis for more details on this? How much more detail do I go into?

As the user selects and de-selects different options, the dataset is filtered using dplyr before being plotted using ggplot2. The selected agricultural systems are plotted on the y axis against either log response ratio or percentage change on the x axis. The log response ratio of each agricultural system compares each to the conventional reference level, which has a log response ratio of zero, and is shown with a blue dashed line. Agricultural systems that have significantly different biodiversity in terms of log response ratio are indicated by blue asterisks.

There is also a table produced which displays selected coefficients from the model and the frequency of instances of each agricultural system that the model is based on. Finally, the user can click a button to show descriptions of the agricultural systems, as well as download the R model summary, or table of coefficients.

The custom model tab is similar, but here the user has the option to run their own model based on what they are interested in. Currently, the user can filter the data to be included in the model based on the biodiversity metric category used by the studies. Once they have made their selections, they press run, and wait up to one minute for the model to run. This is again fitted using a robust model with the same formula as for the default model. An equivalent graph as for the default model is produced. Likewise, the user can choose whether to plot adjusted log response ratio or percentage change, see definitions of the agricultural systems, and download their custom results.

The final tab within the app is the references tab, which provides further details of each paper utilised within the app.

Map of where data comes from

Tabs for other variables.

Definitions of agricultural systems, other terms – what is adjusted LRR, how did we get % change from this? What does 0 LRR of conventional reference actually mean?

Models rather than metafor, which runs models on effect sizes.

Significant results are concluded for results which have a t value greater than 2, or less than -2 due to p values not being provided by the robustllm package.

Include sub-sections/headings

Start more generally – philosophy of shiny app. What is Shiny? – combine analysis and visualisation. Easy to deploy.

Then go more specific.

Packages

* R version 4.2.0 (2022-04-22 ucrt) -- "Vigorous Calisthenics" (Team, 2013)
* Shiny version 1.7.1 (Chang *et al.*, 2017)
* In shiny app server – tidyverse (Wickham *et al.*, 2019)
* In shiny app server – tibble (Müller, 2022)
* In shiny app ui – bslib (for themes)
* robustllm? To fit robust models

Chang, W., Cheng, J., Allaire, J., Xie, Y. and McPherson, J. (2017) Shiny: web application framework for R. *R package version.* 1 (5), 2017.

Müller, K. (2022). *Wickham H. tibble: Simple Data Frames. R package version 2.1. 3. 2019.*

Team, R. C. (2013) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. [*http://www*](http://www)*. R-project. org/.*

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L., François, R., Grolemund, G., Hayes, A., Henry, L. and Hester, J. (2019). *Welcome to the tidyverse. J. Open Source Softw. 4 (43), 1686 (2019).*