Mols analysis example

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1 Methods

1.1 Data manipulation

For this test we will only use the larger ring data

To be able to use `Cover` as a numeric variable, the base level "+" will be transformed into, 1, then transform the variable into numeric and finally scale from 0 to 1. Also there are several taxa that do not appear in all sites, it is assumed that these taxa have a coverage of zero in all of those sites, we add this to the dataset. Then we used the `specnumber` and `diversity` from de vegan package [@Oksanen2020] to calculate species richness and Shannon diversity Index. This result in the pattens shown in figures 1, 2.

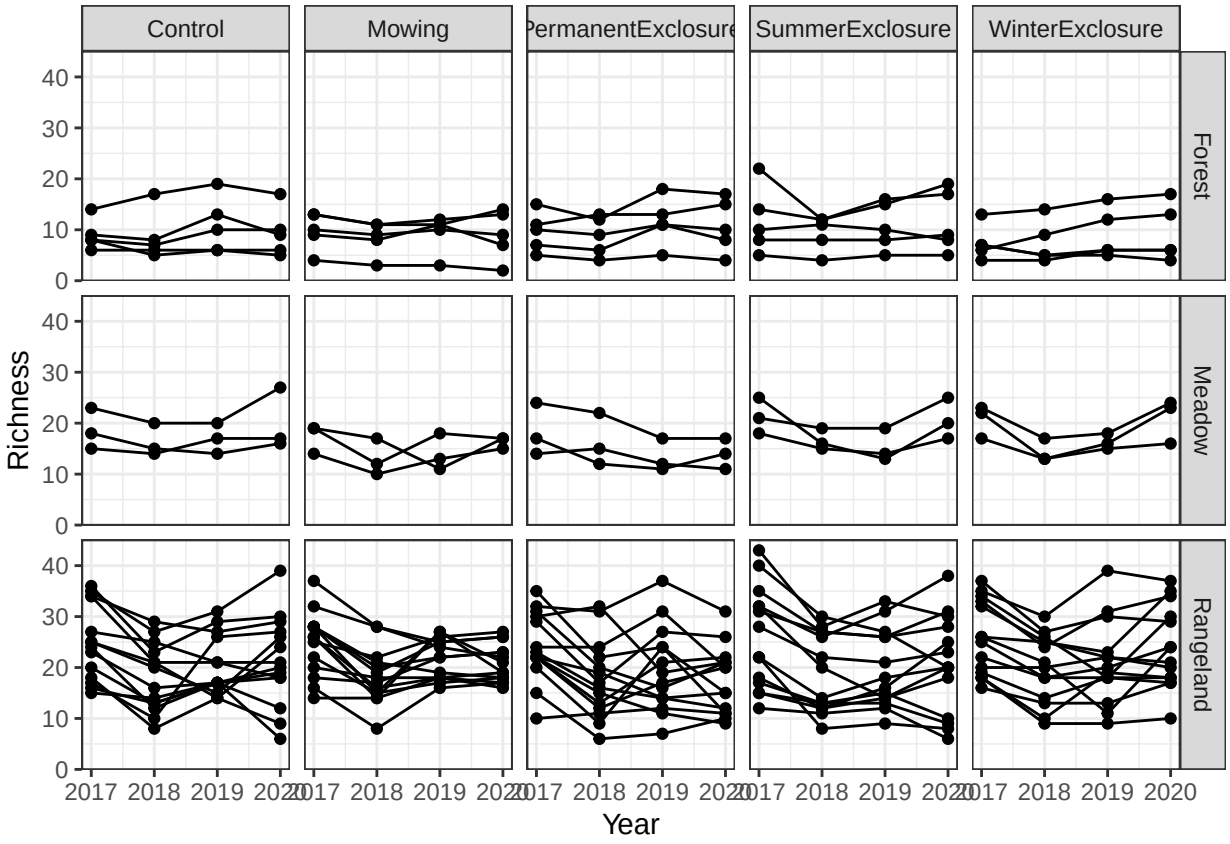

Figure 1: Time series of species richness for each Block, each tile represents a combination of treatment and initial habitat

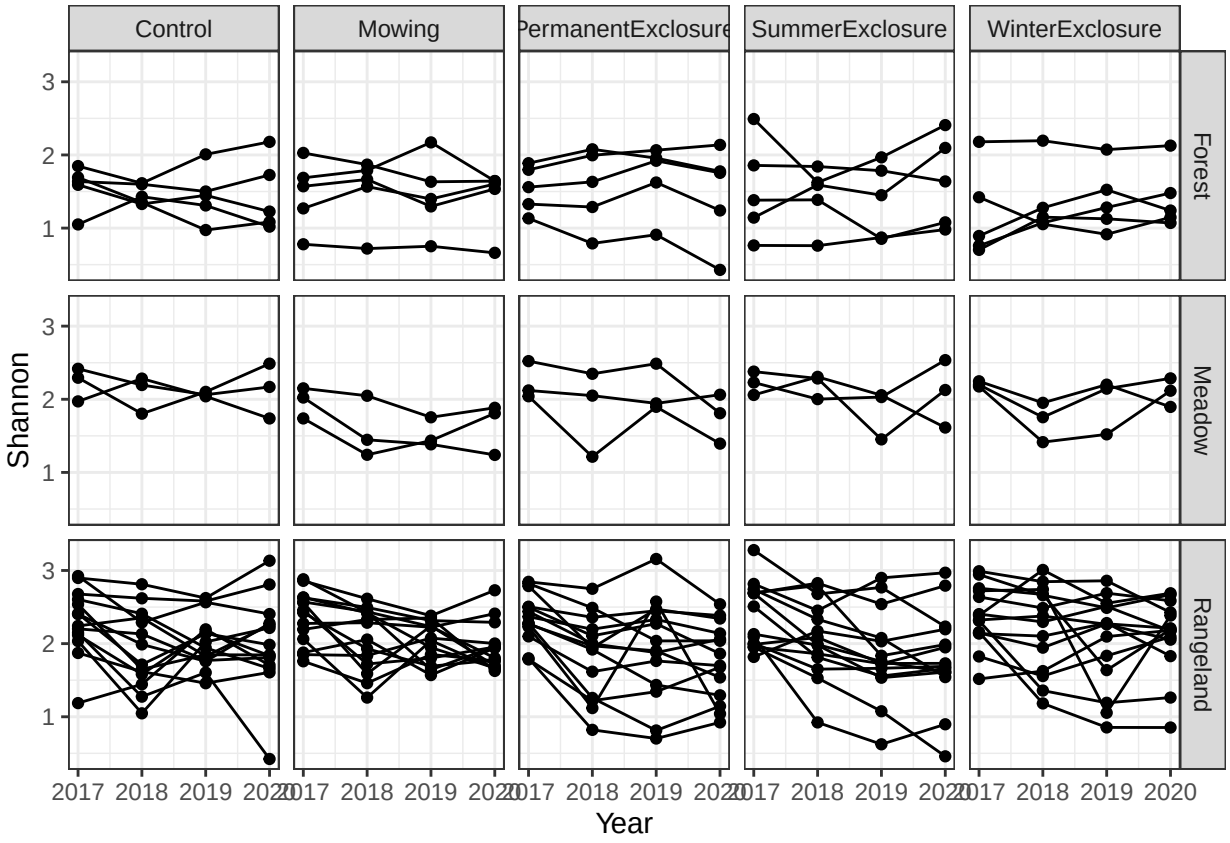

Figure 2: Time series of shannon diversity for each Block, each tile represents a combination of treatment and initial habitat

Table 1: Models that were used for the model average for the same start model

(Intercept)	I((YEAR - 1)^2)	I(abs(YEAR - 1))	aspect	Elevation	InitialHabitat	slope	InitialHabitat:YEAR	Treatment:YEAR	R2m	R2c	AICc
1.94	NA	0.16	NA	0.01	+	NA	+	+	0.51	0.79	2512.73
2.07	NA	0.16	NA	NA	+	NA	+	+	0.49	0.79	2513.29
1.97	NA	0.16	NA	0.01	+	-0.01	+	+	0.51	0.79	2513.54
1.91	-0.03	0.22	NA	0.01	+	NA	+	+	0.51	0.79	2513.59
1.90	NA	0.16	0	0.01	+	NA	+	+	0.51	0.79	2513.92
2.05	-0.03	0.22	NA	NA	+	NA	+	+	0.49	0.79	2514.14
2.12	NA	0.16	NA	NA	+	-0.01	+	+	0.48	0.79	2514.32
1.95	-0.03	0.22	NA	0.01	+	-0.01	+	+	0.51	0.79	2514.41
2.03	NA	0.16	0	NA	+	NA	+	+	0.49	0.79	2514.46

Table 2: Parameters for the model average for the same start model

term	estimate	std.error	statistic	p.value
TreatmentControl:YEAR	0.046	0.020	2.317	0.021
TreatmentMowing:YEAR	0.035	0.020	1.767	0.077
TreatmentSummerExclosure:YEAR	0.042	0.020	2.136	0.033
TreatmentWinterExclosure:YEAR	0.067	0.019	3.458	0.001

1.2 Statistical analysis

The most general mixed model effect was generated using the lme4 package [@bates2010lme4], then all variations of such model were tested using the MuMIn package [@Barton2020] and ranked using the corrected Akaike Information Criterion (AICc). If the best model had at least a difference of two in AICc with the next model the best model was used. If that was not the case, all the models within that range were used to generate a full model average following @anderson2004model.

There where two phenomenons to take into account, the change of diversity, richness or cover for a specific group due to the treatment for each time of initial habitat, and the regional drought from 2018. In order to deal with this we used the following general equatieon:

```
y ~ aspect + Elevation + InitialHabitat + I(abs(YEAR - 1)) + I((YEAR - 1)^2) + slope +
    Treatment:InitialHabitat + YEAR:InitialHabitat + YEAR:Treatment + YEAR:Treatment:InitialHabitat +
    (1 | BlockNo)
```

The Year interaction with Initial Habitat, Treatment or both without adding the Year term on its own ensures that if the year 2017 is coded as year 0 that the effect to be tested will be that if a plot was started in the same block, they should start with the same Richness/Diversity/Taxa cover, whereas the $|(Year - 1)|$ and $(Year - 1)^2$ terms will show the spike or dip that might have been caused by the drought year. For each of the different anayses a glmm with the propper family or basic lmm was performed depending on the nature of the response variable:

- **Richess:** Since richness can only be a discrete positive value, we used a Poisson GLMM
- **Diversity:** For diversity, we did a similar approach but with a regular mixed effects linear model, since the response variable (Shannon's diversity index)

2 Results

2.1 Richness

For the richness model a total of 192 models were tested and we ended up with 9 models to be used to generate an average model. The models with the selected variable parameters and with the marginal and conditional R^2 [@nakagawa2017coefficient] can be seen in table 1 and the parameters of the average model are in table 2, and the response of each treatment for each habitat in average conditions is shown in figure 3.

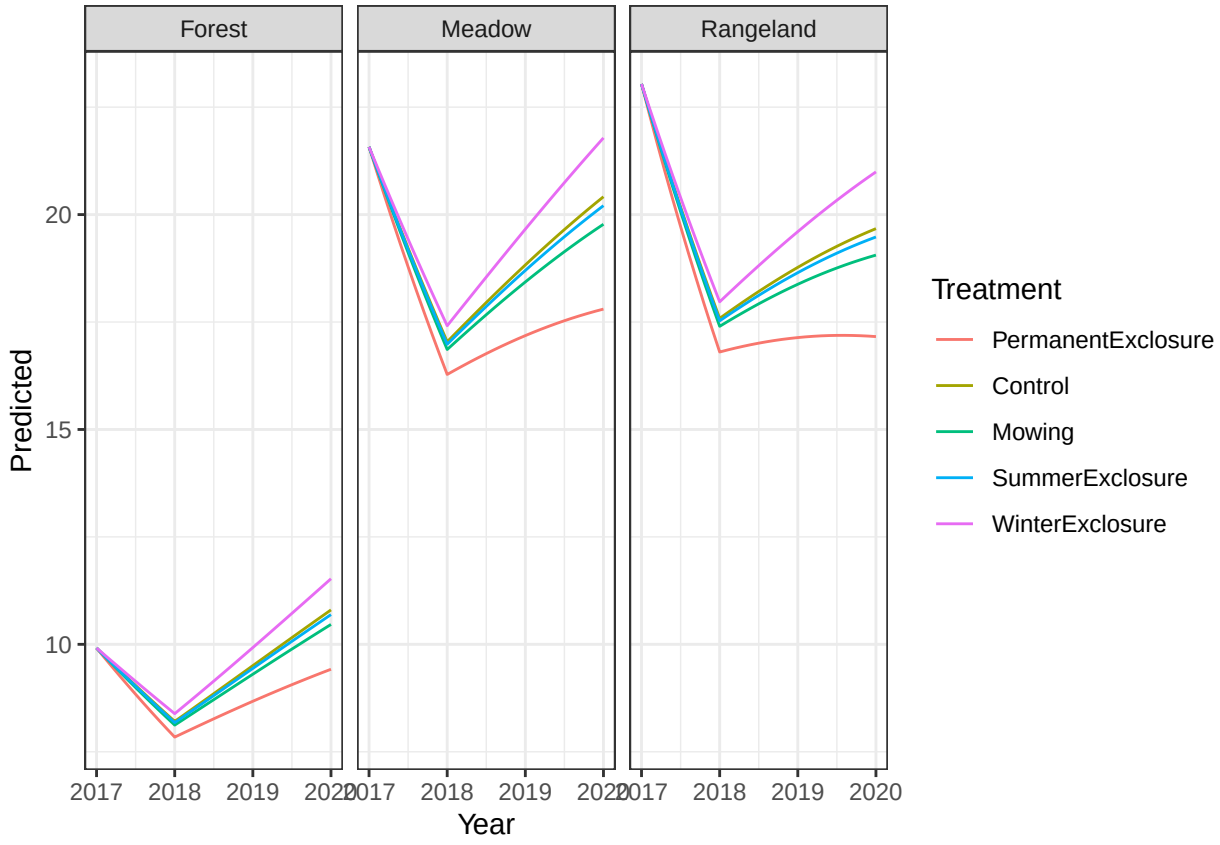

Figure 3: Predicted richness for each treatment and initial habitat

```
## 'r2()' does not support models of class 'averaging'.
```

3 References

4 Reproducibility ticket

```
## - Session info ---------------------------------------------------------------
##  setting  value
##  version  R version 4.0.5 (2021-03-31)
##  os       Ubuntu 18.04.5 LTS
##  system   x86_64, linux-gnu
##  ui       X11
##  language (EN)
##  collate  en_US.UTF-8
##  ctype    en_US.UTF-8
##  tz       America/Santiago
##  date     2021-04-13
##
## - Packages -------------------------------------------------------------------
##  package      * version  date       lib source
##  assertthat     0.2.1    2019-03-21 [1] CRAN (R 4.0.4)
##  backports      1.2.1    2020-12-09 [1] CRAN (R 4.0.4)
##  bayestestR     0.8.2    2021-01-26 [1] CRAN (R 4.0.4)
##  bookdown       0.21     2020-10-13 [1] CRAN (R 4.0.4)
##  boot           1.3-27   2021-02-12 [1] CRAN (R 4.0.4)
##  broom          0.7.5    2021-02-19 [1] CRAN (R 4.0.4)
##  broom.mixed    0.2.6    2020-05-17 [1] CRAN (R 4.0.4)
##  broomExtra   * 4.2.1    2021-02-21 [1] CRAN (R 4.0.4)
##  cachem         1.0.4    2021-02-13 [1] CRAN (R 4.0.4)
##  callr          3.5.1    2020-10-13 [1] CRAN (R 4.0.4)
##  cellranger     1.1.0    2016-07-27 [1] CRAN (R 4.0.4)
##  cli            2.3.1    2021-02-23 [1] CRAN (R 4.0.4)
##  coda           0.19-4   2020-09-30 [1] CRAN (R 4.0.4)
##  codetools      0.2-18   2020-11-04 [1] CRAN (R 4.0.4)
##  colorspace     2.0-0    2020-11-11 [1] CRAN (R 4.0.4)
##  crayon         1.4.1    2021-02-08 [1] CRAN (R 4.0.4)
##  DBI            1.1.1    2021-01-15 [1] CRAN (R 4.0.4)
##  dbplyr         2.1.0    2021-02-03 [1] CRAN (R 4.0.4)
##  desc           1.3.0    2021-03-05 [1] CRAN (R 4.0.4)
##  devtools       2.3.2    2020-09-18 [1] CRAN (R 4.0.4)
##  digest         0.6.27   2020-10-24 [1] CRAN (R 4.0.4)
##  doParallel   * 1.0.16   2020-10-16 [1] CRAN (R 4.0.4)
##  dplyr        * 1.0.5    2021-03-05 [1] CRAN (R 4.0.4)
##  effectsize     0.4.4    2021-03-14 [1] CRAN (R 4.0.4)
##  ellipsis       0.3.1    2020-05-15 [1] CRAN (R 4.0.4)
##  emmeans        1.5.5-1  2021-03-21 [1] CRAN (R 4.0.4)
##  estimability   1.3      2018-02-11 [1] CRAN (R 4.0.4)
##  evaluate       0.14     2019-05-28 [1] CRAN (R 4.0.4)
##  fansi          0.4.2    2021-01-15 [1] CRAN (R 4.0.4)
##  farver         2.1.0    2021-02-28 [1] CRAN (R 4.0.4)
##  fastmap        1.1.0    2021-01-25 [1] CRAN (R 4.0.4)
##  forcats      * 0.5.1    2021-01-27 [1] CRAN (R 4.0.4)
##  foreach      * 1.5.1    2020-10-15 [1] CRAN (R 4.0.4)
```

```
##  formatR        1.8      2021-03-12 [1] CRAN (R 4.0.4)
##  fs             1.5.0    2020-07-31 [1] CRAN (R 4.0.4)
##  generics       0.1.0    2020-10-31 [1] CRAN (R 4.0.4)
##  ggplot2      * 3.3.3    2020-12-30 [1] CRAN (R 4.0.4)
##  glue           1.4.2    2020-08-27 [1] CRAN (R 4.0.4)
##  gtable         0.3.0    2019-03-25 [1] CRAN (R 4.0.4)
##  haven          2.3.1    2020-06-01 [1] CRAN (R 4.0.4)
##  highr          0.8      2019-03-20 [1] CRAN (R 4.0.4)
##  hms            1.0.0    2021-01-13 [1] CRAN (R 4.0.4)
##  htmltools      0.5.1.1  2021-01-22 [1] CRAN (R 4.0.4)
##  httr           1.4.2    2020-07-20 [1] CRAN (R 4.0.4)
##  insight        0.13.1   2021-02-22 [1] CRAN (R 4.0.4)
##  iterators    * 1.0.13   2020-10-15 [1] CRAN (R 4.0.4)
##  jsonlite       1.7.2    2020-12-09 [1] CRAN (R 4.0.4)
##  kableExtra   * 1.3.4    2021-02-20 [1] CRAN (R 4.0.4)
##  knitr          1.31     2021-01-27 [1] CRAN (R 4.0.4)
##  labeling       0.4.2    2020-10-20 [1] CRAN (R 4.0.4)
##  lattice        0.20-41  2020-04-02 [1] CRAN (R 4.0.4)
##  lifecycle      1.0.0    2021-02-15 [1] CRAN (R 4.0.4)
##  lme4         * 1.1-26   2020-12-01 [1] CRAN (R 4.0.4)
##  lubridate      1.7.10   2021-02-26 [1] CRAN (R 4.0.4)
##  magrittr       2.0.1    2020-11-17 [1] CRAN (R 4.0.4)
##  MASS           7.3-53.1 2021-02-12 [1] CRAN (R 4.0.4)
##  Matrix       * 1.3-2    2021-01-06 [1] CRAN (R 4.0.4)
##  memoise        2.0.0    2021-01-26 [1] CRAN (R 4.0.4)
##  minqa          1.2.4    2014-10-09 [1] CRAN (R 4.0.4)
##  modelr         0.1.8    2020-05-19 [1] CRAN (R 4.0.4)
##  multcomp       1.4-16   2021-02-08 [1] CRAN (R 4.0.5)
##  MuMIn        * 1.43.17  2020-04-15 [1] CRAN (R 4.0.4)
##  munsell        0.5.0    2018-06-12 [1] CRAN (R 4.0.4)
##  mvtnorm        1.1-1    2020-06-09 [1] CRAN (R 4.0.4)
##  nlme           3.1-152  2021-02-04 [1] CRAN (R 4.0.4)
##  nloptr         1.2.2.2  2020-07-02 [1] CRAN (R 4.0.4)
##  parameters     0.12.0   2021-02-21 [1] CRAN (R 4.0.4)
##  performance    0.7.0    2021-02-03 [1] CRAN (R 4.0.4)
##  pillar         1.5.1    2021-03-05 [1] CRAN (R 4.0.4)
##  pkgbuild       1.2.0    2020-12-15 [1] CRAN (R 4.0.4)
##  pkgconfig      2.0.3    2019-09-22 [1] CRAN (R 4.0.4)
##  pkgload        1.2.0    2021-02-23 [1] CRAN (R 4.0.4)
##  plyr           1.8.6    2020-03-03 [1] CRAN (R 4.0.4)
##  prettyunits    1.1.1    2020-01-24 [1] CRAN (R 4.0.4)
##  processx       3.5.0    2021-03-23 [1] CRAN (R 4.0.4)
##  ps             1.6.0    2021-02-28 [1] CRAN (R 4.0.4)
##  purrr        * 0.3.4    2020-04-17 [1] CRAN (R 4.0.4)
##  R6             2.5.0    2020-10-28 [1] CRAN (R 4.0.4)
##  Rcpp           1.0.6    2021-01-15 [1] CRAN (R 4.0.4)
##  readr        * 1.4.0    2020-10-05 [1] CRAN (R 4.0.4)
##  readxl         1.3.1    2019-03-13 [1] CRAN (R 4.0.4)
##  remotes        2.2.0    2020-07-21 [1] CRAN (R 4.0.4)
##  reprex         1.0.0    2021-01-27 [1] CRAN (R 4.0.4)
##  reshape2       1.4.4    2020-04-09 [1] CRAN (R 4.0.4)
##  rlang          0.4.10   2020-12-30 [1] CRAN (R 4.0.4)
##  rmarkdown      2.7      2021-02-19 [1] CRAN (R 4.0.4)
##  rprojroot      2.0.2    2020-11-15 [1] CRAN (R 4.0.4)
```

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##  rstudioapi     0.13     2020-11-12 [1] CRAN (R 4.0.4)
##  rvest          1.0.0    2021-03-09 [1] CRAN (R 4.0.4)
##  sandwich       3.0-0    2020-10-02 [1] CRAN (R 4.0.4)
##  scales         1.1.1    2020-05-11 [1] CRAN (R 4.0.4)
##  sessioninfo    1.1.1    2018-11-05 [1] CRAN (R 4.0.4)
##  statmod        1.4.35   2020-10-19 [1] CRAN (R 4.0.4)
##  stringi        1.5.3    2020-09-09 [1] CRAN (R 4.0.4)
##  stringr      * 1.4.0    2019-02-10 [1] CRAN (R 4.0.4)
##  survival       3.2-10   2021-03-16 [1] CRAN (R 4.0.4)
##  svglite        2.0.0    2021-02-20 [1] CRAN (R 4.0.4)
##  systemfonts    1.0.1    2021-02-09 [1] CRAN (R 4.0.4)
##  testthat       3.0.2    2021-02-14 [1] CRAN (R 4.0.4)
##  TH.data        1.0-10   2019-01-21 [1] CRAN (R 4.0.4)
##  tibble       * 3.1.0    2021-02-25 [1] CRAN (R 4.0.4)
##  tidyr        * 1.1.3    2021-03-03 [1] CRAN (R 4.0.4)
##  tidyselect     1.1.0    2020-05-11 [1] CRAN (R 4.0.4)
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##  usethis        2.0.1    2021-02-10 [1] CRAN (R 4.0.4)
##  utf8           1.2.1    2021-03-12 [1] CRAN (R 4.0.4)
##  vctrs          0.3.7    2021-03-29 [1] CRAN (R 4.0.4)
##  viridisLite    0.3.0    2018-02-01 [1] CRAN (R 4.0.4)
##  webshot        0.5.2    2019-11-22 [1] CRAN (R 4.0.4)
##  withr          2.4.1    2021-01-26 [1] CRAN (R 4.0.4)
##  xfun           0.22     2021-03-11 [1] CRAN (R 4.0.4)
##  xml2           1.3.2    2020-04-23 [1] CRAN (R 4.0.4)
##  xtable         1.8-4    2019-04-21 [1] CRAN (R 4.0.4)
##  yaml           2.2.1    2020-02-01 [1] CRAN (R 4.0.4)
##  zoo            1.8-9    2021-03-09 [1] CRAN (R 4.0.4)
##
## [1] /home/derek/R/x86_64-pc-linux-gnu-library/4.0
## [2] /usr/local/lib/R/site-library
## [3] /usr/lib/R/site-library
## [4] /usr/lib/R/library
```