CODECHECK certificate 2020-008

http://doi.org/10.5281/zenodo.3746024

Item	Value
Title	The effect of non-pharmaceutical interventions on COVID-19 cases, deaths and demand for hospital services in the UK: a modelling study
Authors	Nicholas G. Davies, Adam J. Kucharski, Rosalind M. Eggo, Amy Gimma, CMMID COVID-19 working group, W. John Edmunds
Reference	https://cmmid.github.io/topics/covid19/control-measures/report/uk_scenario_modelling_preprint_2020_04_01.pdf
Codechecker	Stephen J. Eglen https://orcid.org/0000-0001-8607-8025
Date of check:	2020-04-09 09:40:00
Summary:	Analysis steps took several days; otherwise mostly straightforward.
Repository:	https://github.com/codecheckers/covid-uk

Table 1: CODECHECK summary

File	Comment	Size
fig-12week.pdf	manuscript Figure 2 – impact of interventions lasting 12 weeks.	223104
table-12week.csv	manuscript Table 4 – project impact of 12-week interventions.	1192
fig-triggers.pdf	manuscript Figure 3 – local vs national triggering.	157655
fig-misc.pdf	manuscript Figure 4 – reducing leisure events/impact of increased childcare.	10915
fig-lockdown.pdf	manuscript Figure 5 – intensive control measures.	192309
table-lockdown.csv	manuscipt Table 5 – intensive control measures.	1149
table-triggers.csv	mansuscript Table S3 – impact of control measures with local vs national triggering.	1785
table-sports.csv	mansuscript Table S4 – impact of leisure control measures.	863
table-grandparents.csv	mansuscript Table S5 – impact of school closures and care by elders.	1229

Table 2: Summary of output files generated

Summary

I was able to reproduce the figures and tables in the paper. The simulations took several days to run, and so in the codechecker repo I have included the results of the simulations (the `*.qs` files). The figures however

are not included in the main section of the repo, but are in the `codecheck/outputs` folder.

CODECHECKER notes

The github repo https://github.com/cmmid/covid-uk contained all the necessary code. I needed some system installations and R packages, but then was able to run the code.

Extra software installations

Several extra linux and R packages were required. These are documented in the file `install.R`, shown here:

```
## Add a script for installing required packages

install.packages(c("rlang", "stringr", "qs", "cowplot", "data.table"))
install.packages(c("ggplot2", "Rcpp", "lubridate", "nloptr", "HDInterval"))

## To install the following package, we also need GSL to be installed
## within linux.
## On arch I did this using:
## sudo pacman -S gsl
## Does this mean that I will need a Dockerfile rather than just
## use the binder text files to set up R?
install.packages("RcppGSL")

## Also, nlopt package is required.
## yaourt -S nlopt

## For running jobs in parallel
## sudo pacman -S parallel
```

I ran this on arch linux, but a Dockerfile is also available.

Running the software to regenerate outputs.

The only significant change to the two scripts was to ensure covid path was the current directory WITH a trailing slash.

```
covid_uk_path = "./"
```

I created a script to run the jobs in parallel on a cluster, `run-jobs.sh`.

```
## Run all the covid-ukjobs.
##
## This can be run using GNU parallel:
## parallel --jobs 2 < run-jobs.sh
Rscript UK.R 1 50   > case_1.stdout
Rscript UK.R 2.1 50 > case_2.1.stdout
Rscript UK.R 2.2 50 > case_2.2.stdout
Rscript UK.R 3 50   > case_3.stdout
Rscript UK.R 4 50   > case_4.stdout
Rscript UK.R 5 50   > case_5.stdout
Rscript UK.R 6 50   > case_6.stdout
```

The `*.stdout` files capture the output from each run; for each run, there are two output files, e.g. for run 1: `1-dynamics.qs` and `1-totals.qs`. These `*.qs` files are then processed by the script `UK-view.R` to make the output figures.

```
Rscript UK-view.R
```

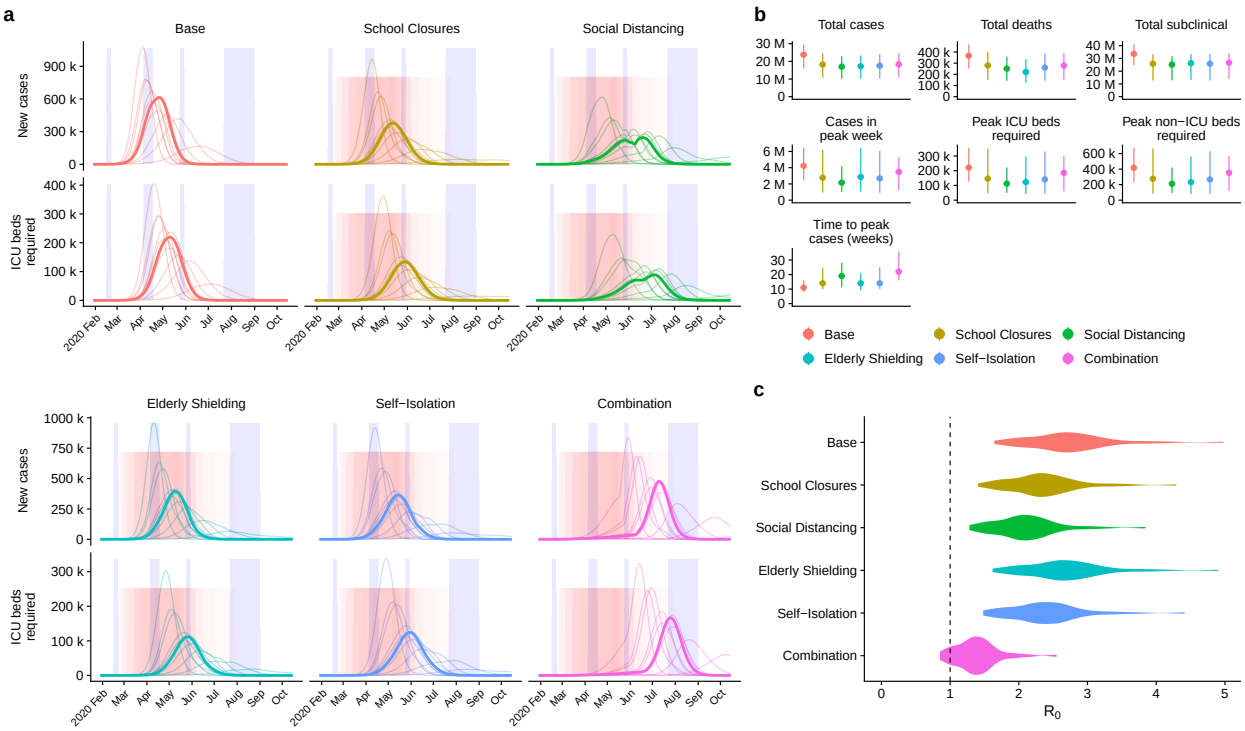

Figure C1: manuscript Figure 2 – impact of interventions lasting 12 weeks.

statistic	Base	School.Closures	Social.Distancing	Elderly.Shielding	Self.Isolation	Combination
Total cases	24 M (16 M–30 M)	18 M (11 M–25 M)	17 M (10 M–23 M)	17 M (10 M–23 M)	18 M (10 M–24 M)	18 M (11 M–24 M)
Total deaths	370 k (250 k–470 k)	280 k (150 k–400 k)	250 k (140 k–360 k)	220 k (130 k–330 k)	260 k (140 k–390 k)	280 k (150 k–390 k)
Cases in peak week	4.2 M (2.5 M–6.4 M)	2.8 M (940 k–6.2 M)	2.2 M (1 M–4.2 M)	2.9 M (1.1 M–6.4 M)	2.7 M (900 k–6.1 M)	3.5 M (1.2 M–5.3 M)
Deaths in peak week	62 k (35 k–98 k)	41 k (13 k–96 k)	31 k (14 k–62 k)	34 k (12 k–79 k)	39 k (12 k–92 k)	51 k (17 k–82 k)
Peak ICU beds required	220 k (120 k–360 k)	150 k (45 k–350 k)	110 k (49 k–220 k)	120 k (42 k–300 k)	140 k (44 k–330 k)	190 k (61 k–300 k)
Peak non-ICU beds required	420 k (230 k–670 k)	280 k (85 k–670 k)	210 k (92 k–420 k)	230 k (79 k–560 k)	270 k (83 k–630 k)	350 k (120 k–570 k)
Time to peak cases (weeks)	11 (8.2–16)	14 (10–25)	19 (11–28)	14 (9.2–21)	14 (10–25)	22 (16–36)
Total subclinical	34 M (25 M–41 M)	26 M (13 M–33 M)	25 M (13 M–32 M)	26 M (13 M–33 M)	26 M (13 M–34 M)	27 M (14 M–34 M)

Table C1: manuscript Table 4 – project impact of 12-week interventions.

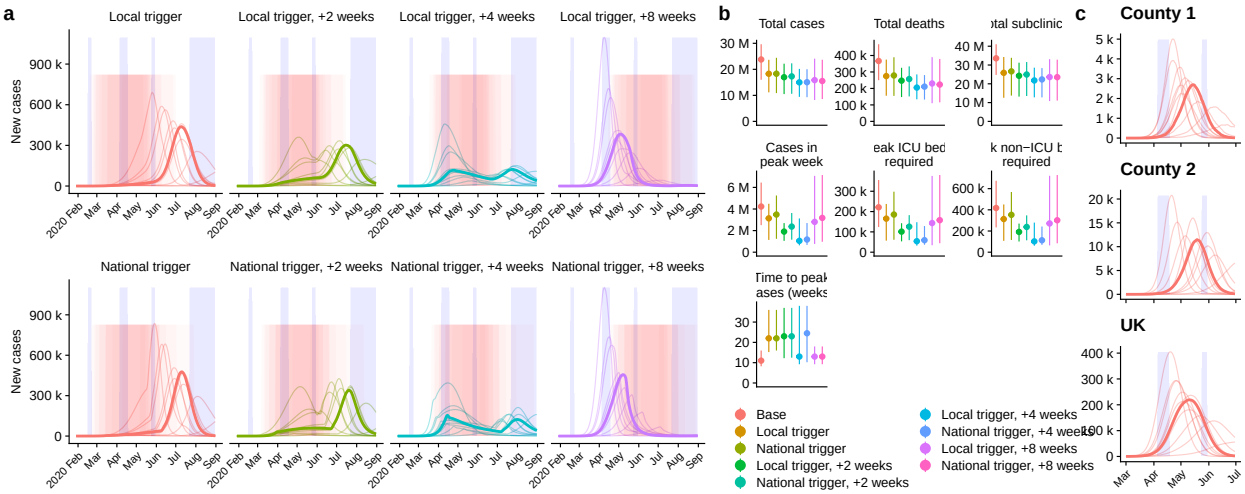

Figure C2: manuscript Figure 3 – local vs national triggering.

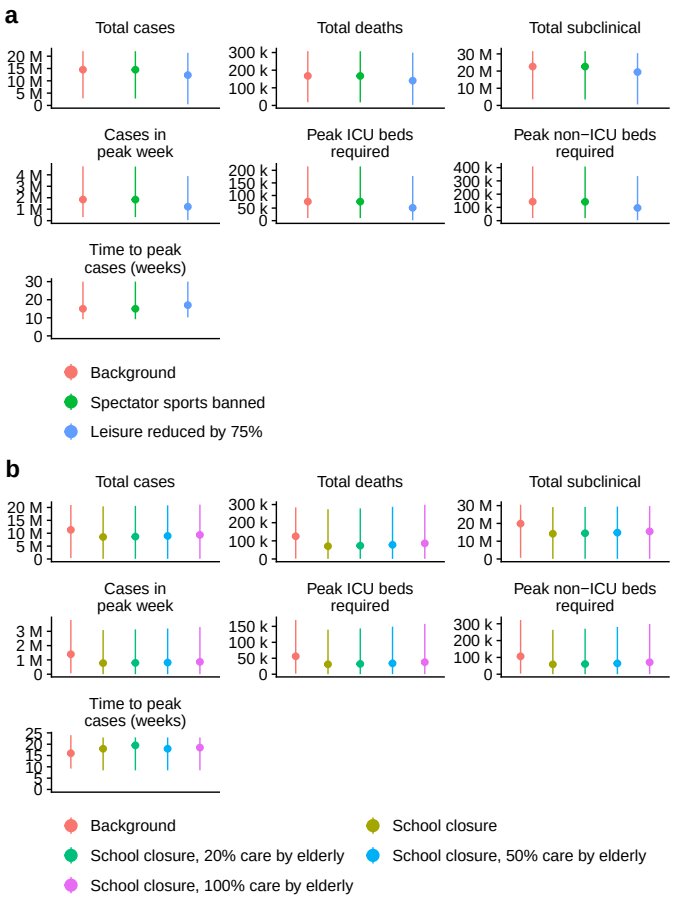

Figure C3: manuscript Figure 4 – reducing leisure events/impact of increased childcare.

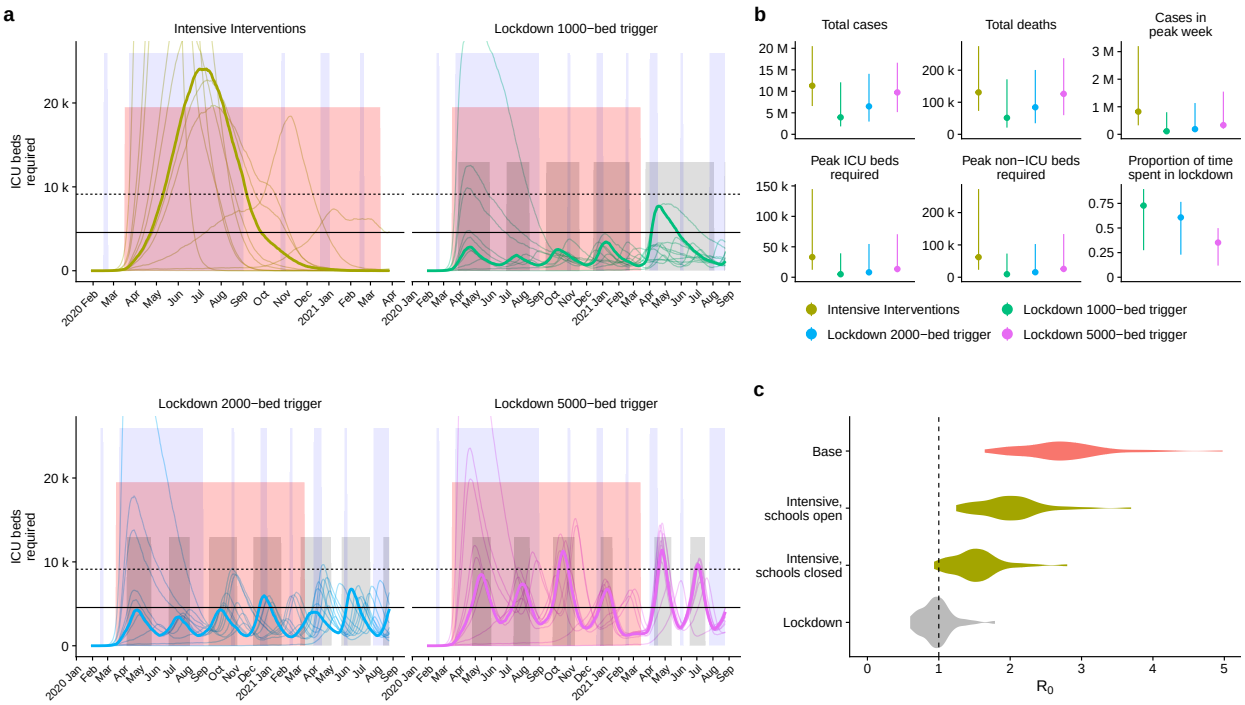

Figure C4: manuscript Figure 5 – intensive control measures.

statistic	Base	Intensive.Interventions	Lockdown.1000.bed.trigger	Lockdown.2000.bed.trigger	Lockdown.5000.bed.trigger
Total cases	24 M (16 M–30 M)	11 M (6.6 M–21 M)	4 M (1.8 M–12 M)	6.5 M (3 M–14 M)	9.7 M (5.2 M–17 M)
Total deaths	370 k (250 k–470 k)	130 k (73 k–270 k)	51 k (21 k–170 k)	84 k (34 k–200 k)	130 k (60 k–240 k)
Cases in peak week	4.2 M (2.5 M–6.4 M)	820 k (330 k–3.2 M)	110 k (79 k–800 k)	190 k (110 k–1.1 M)	330 k (200 k–1.5 M)
Deaths in peak week	62 k (35 k–98 k)	9.3 k (3.5 k–40 k)	1.4 k (850–11 k)	2.3 k (1.3 k–15 k)	3.7 k (2.3 k–20 k)
Peak ICU beds required	220 k (120 k–360 k)	33 k (12 k–140 k)	5 k (3.2 k–39 k)	8.1 k (4.8 k–55 k)	13 k (8.4 k–71 k)
Peak non-ICU beds required	420 k (230 k–670 k)	62 k (23 k–270 k)	9.4 k (6.2 k–73 k)	16 k (9 k–100 k)	26 k (16 k–130 k)
Time to peak cases (weeks)	11 (8.2–16)	19 (9.2–66)	60 (8–96)	46 (8–71)	34 (8–63)
Proportion of time spent in lockdown			0.73 (0.27–0.9)	0.61 (0.23–0.77)	0.35 (0.12–0.5)
Total subclinical	34 M (25 M–41 M)	18 M (10 M–29 M)	7.1 M (2.5 M–21 M)	11 M (3.9 M–23 M)	16 M (6.6 M–25 M)

Table C2: manuscipt Table 5 – intensive control measures.

statistic	Base	Local.trigger	National.trigger	Local.trigger...2.weeks	National.trigger...2.weeks	Local.trigger...4.weeks	National.trigger...4.weeks	Local.trigger...8.weeks	National.trigger...8.wee
Total cases	24 M (16 M–30 M)	18 M (11 M–24 M)	18 M (11 M–24 M)	17 M (10 M–22 M)	17 M (11 M–22 M)	15 M (9.4 M–20 M)	15 M (9.3 M–20 M)	16 M (8.2 M–24 M)	16 M (8.6 M–24 M)
Total deaths	370 k (250 k–470 k)	280 k (160 k–370 k)	280 k (150 k–390 k)	250 k (150 k–330 k)	260 k (150 k–330 k)	210 k (130 k–290 k)	210 k (130 k–280 k)	230 k (110 k–390 k)	220 k (120 k–380 k)
Cases in peak week	4.2 M (2.5 M–6.4 M)	3.1 M (1.1 M–4.5 M)	3.5 M (1.2 M–5.3 M)	1.9 M (1 M–2.7 M)	2.4 M (1.2 M–3.6 M)	1.1 M (630 k–3.1 M)	1.2 M (670 k–2.7 M)	2.8 M (760 k–7.1 M)	3.2 M (970 k–7.1 M)
Deaths in peak week	62 k (35 k–98 k)	45 k (16 k–66 k)	51 k (17 k–82 k)	28 k (15 k–40 k)	35 k (17 k–50 k)	15 k (9 k–41 k)	17 k (10 k–36 k)	40 k (9.5 k–99 k)	43 k (12 k–100 k)
Peak ICU beds required	220 k (120 k–360 k)	170 k (57 k–240 k)	190 k (61 k–300 k)	100 k (53 k–140 k)	130 k (59 k–180 k)	54 k (32 k–150 k)	59 k (37 k–130 k)	140 k (34 k–380 k)	160 k (44 k–380 k)
Peak non-ICU beds required	420 k (230 k–670 k)	310 k (110 k–450 k)	350 k (120 k–570 k)	190 k (100 k–270 k)	240 k (110 k–350 k)	100 k (61 k–280 k)	110 k (70 k–240 k)	270 k (64 k–720 k)	300 k (84 k–730 k)
Time to peak cases (weeks)	11 (8.2–16)	22 (15–36)	22 (16–36)	23 (12–37)	23 (12–37)	13 (9.2–38)	24 (10–38)	13 (9.2–18)	13 (9.2–18)
Total subclinical	34 M (25 M–41 M)	26 M (13 M–34 M)	27 M (14 M–34 M)	24 M (13 M–31 M)	25 M (14 M–32 M)	22 M (13 M–29 M)	22 M (13 M–28 M)	24 M (11 M–33 M)	24 M (11 M–33 M)

Table C3: mansuscript Table S3 – impact of control measures with local vs national triggering.

statistic	Base	Background	Spectator.sports.banned	Leisure.reduced.by.75.
Total cases	24 M (16 M–30 M)	15 M (2.9 M–22 M)	15 M (2.8 M–22 M)	12 M (470 k–21 M)
Total deaths	370 k (250 k–470 k)	170 k (18 k–310 k)	170 k (18 k–310 k)	140 k (3.3 k–300 k)
Cases in peak week	4.2 M (2.5 M–6.4 M)	1.8 M (310 k–4.7 M)	1.8 M (310 k–4.7 M)	1.2 M (47 k–3.9 M)
Deaths in peak week	62 k (35 k–98 k)	21 k (2.7 k–61 k)	21 k (2.6 k–60 k)	14 k (360–49 k)
Peak ICU beds required	220 k (120 k–360 k)	76 k (11 k–220 k)	76 k (10 k–220 k)	51 k (1.5 k–180 k)
Peak non-ICU beds required	420 k (230 k–670 k)	140 k (20 k–410 k)	140 k (19 k–410 k)	96 k (2.8 k–340 k)
Time to peak cases (weeks)	11 (8.2–16)	15 (9.2–30)	15 (9.2–30)	17 (10–30)
Total subclinical	34 M (25 M–41 M)	23 M (3.6 M–32 M)	23 M (3.5 M–32 M)	19 M (590 k–30 M)

Table C4: mansuscript Table S4 – impact of leisure control measures.

statistic	Base	Background	School.closure	School.closure..20..care.by.elderly	School.closure..50..care.by.elderly	School.closure..100..car
Total cases	24 M (16 M–30 M)	11 M (400 k–21 M)	8.5 M (64 k–20 M)	8.7 M (66 k–21 M)	8.9 M (63 k–21 M)	9.3 M (75 k–21 M)
Total deaths	370 k (250 k–470 k)	130 k (2 k–280 k)	71 k (550–270 k)	73 k (590–280 k)	78 k (530–290 k)	86 k (650–300 k)
Cases in peak week	4.2 M (2.5 M–6.4 M)	1.4 M (63 k–3.8 M)	780 k (3.5 k–3.1 M)	790 k (3.6 k–3.1 M)	820 k (3.4 k–3.2 M)	860 k (4.5 k–3.3 M)
Deaths in peak week	62 k (35 k–98 k)	16 k (320–48 k)	8.8 k (40–39 k)	9.1 k (49–40 k)	9.6 k (42–42 k)	11 k (54–44 k)
Peak ICU beds required	220 k (120 k–360 k)	56 k (1.7 k–170 k)	31 k (140–140 k)	32 k (140–140 k)	34 k (150–150 k)	38 k (180–160 k)
Peak non-ICU beds required	420 k (230 k–670 k)	110 k (3.4 k–320 k)	59 k (260–260 k)	61 k (250–270 k)	64 k (260–280 k)	71 k (330–300 k)
Time to peak cases (weeks)	11 (8.2–16)	16 (9.2–24)	18 (8.5–23)	20 (8.5–23)	18 (8.5–23)	18 (8.5–23)
Total subclinical	34 M (24 M–41 M)	20 M (670 k–31 M)	14 M (82 k–29 M)	14 M (84 k–29 M)	15 M (81 k–29 M)	15 M (96 k–30 M)

Table C5: mansuscript Table S5 – impact of school closures and care by elders.

About this document

This document was created using Rmarkdown. `make codecheck.pdf` will regenerate the file.

```
sessionInfo()
```

```
## R version 3.6.3 (2020-02-29)
## Platform: x86_64-pc-linux-gnu (64-bit)
## Running under: Manjaro Linux
##
## Matrix products: default
## BLAS:   /usr/lib/libopenblasp-r0.3.9.so
## LAPACK: /usr/lib/liblapack.so.3.9.0
##
## locale:
##  [1] LC_CTYPE=en_GB.UTF-8       LC_NUMERIC=C
##  [3] LC_TIME=en_GB.UTF-8        LC_COLLATE=en_GB.UTF-8
##  [5] LC_MONETARY=en_GB.UTF-8    LC_MESSAGES=en_GB.UTF-8
##  [7] LC_PAPER=en_GB.UTF-8       LC_NAME=C
##  [9] LC_ADDRESS=C               LC_TELEPHONE=C
## [11] LC_MEASUREMENT=en_GB.UTF-8 LC_IDENTIFICATION=C
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets
## [6] methods   base
##
## other attached packages:
## [1] rprojroot_1.3-2 readr_1.3.1     tibble_2.1.3
## [4] yaml_2.2.0      xtable_1.8-3    knitr_1.26
##
## loaded via a namespace (and not attached):
##  [1] Rcpp_1.0.3      digest_0.6.23   crayon_1.3.4
##  [4] R6_2.4.1        backports_1.1.4 magrittr_1.5
##  [7] evaluate_0.14   highr_0.8       pillar_1.4.1
## [10] rlang_0.4.2     stringi_1.4.3   rmarkdown_1.18
## [13] tools_3.6.3     stringr_1.4.0   hms_0.4.2
## [16] xfun_0.11       compiler_3.6.3  pkgconfig_2.0.2
## [19] htmltools_0.4.0
```