

# $R_0$ figure for SARS-CoV-2 Random Walk Epidemiological Model

Andrew Chu<sup>1</sup>, Greg Huber<sup>1</sup>, Aaron McGeever<sup>1</sup>, Boris Veytsman<sup>2</sup>, and David Yllanes<sup>1</sup>

<sup>1</sup>Chan Zuckerberg Biohub, 499 Illinois Street, San Francisco, CA 94158, USA

<sup>2</sup>Chan Zuckerberg Initiative, 601 Marshall St, Redwood City, CA 94063, USA

## ABSTRACT

Here we generate figures for the random walkers paper.

Setting things up:

```
opts_chunk$set(  
  dev='tikz',  
  cache=T  
)  
#options(tikzDefaultEngine='luatex')  
library(tidyverse)  
  
## - Attaching packages ----- tidyverse 1.3.0 -  
## v ggplot2 3.3.2      v purrr 0.3.4  
## v tibble 3.0.3       v dplyr 1.0.2  
## v tidyr 1.1.2        v stringr 1.4.0  
## v readr 1.3.1        v forcats 0.5.0  
## - Conflicts ----- tidyverse_conflicts() -  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag()     masks stats::lag()  
  
library(ggthemes)  
theme_set(theme_bw())
```

Reading the data:

```
data <- read_csv("../data/R0griddata.csv.gz")  
  
## Parsed with column specification:  
## cols(  
##   p = col_double(),  
##   tau = col_double(),  
##   r0 = col_double()  
## )  
  
data  
  
## # A tibble: 340 x 3  
##       p     tau    r0  
##   <dbl> <dbl> <dbl>  
## 1  0.1     1 0.101  
## 2  0.2     1 0.199  
## 3  0.3     1 0.3  
## 4  0.4     1 0.399  
## 5  0.5     1 0.501  
## 6  0.6     1 0.601
```

```
## 7 0.7 1 0.701
## 8 0.8 1 0.8
## 9 0.9 1 0.898
## 10 1 1 0.999
## # ... with 330 more rows
```

First, naïve prediction

```
data <- data %>% mutate(naive=p*tau)
```

Now, the theoretical prediction. Let us use zero adjustable parameters, taking  $c_2$  from the structure factor and assuming  $q_0 = 1$ :

```
c2 <- 0.4575445
K <- 1/(4*pi*c2)
K

## [1] 0.1739229

tau0 <- 1/c2
tau0

## [1] 2.18558

data <- data %>% mutate(exact=p*tau/(1+K*p*log(tau/tau0))) %>%
  pivot_longer(cols=c('naive', 'exact'), names_to='type',
               values_to='prediction') %>%
  mutate(type=factor(type, levels=c('naive', 'exact'),
                      labels=c('Naïve prediction',
                               'Exact prediction')))
```

```
ggplot(data) + geom_point(aes(prediction,
  r0, color=as.factor(p))) +
  xlim(0,100) + ylim(0,100) +
  coord_fixed(ratio=1) +
  facet_wrap(~type, nrow=1) +
  geom_abline(intercept=0, slope=1) +
  xlab("$R_0^{\\text{predicted}}") +
  ylab("$R_0^{\\text{simulated}}") +
  labs(color="$p") + coord_fixed()
```

*## Coordinate system already present. Adding new coordinate system, which will replace the existing one.*

