

# Probability and Conditional Probability

Introduction to Quantitative Social Science

Xiaolong Yang University of Tokyo

Summer 2022

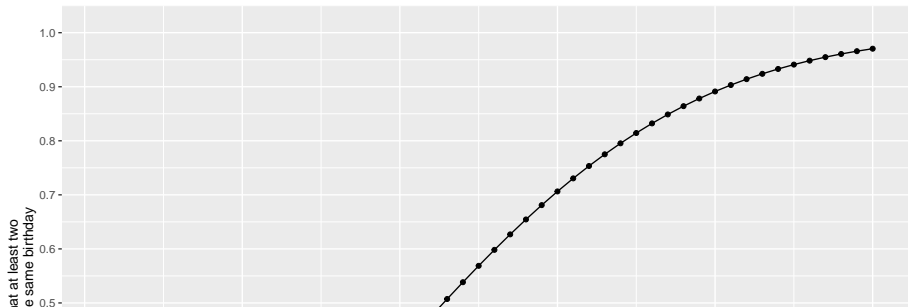
# Birthday Problem

```
## write the birthday function  
birthday <- function(k) {  
  logdenom <- k * log(365) + lfactorial(365 - k)  
  lognumer <- lfactorial(365)  
  pr <- 1 - exp(lognumer - logdenom)  
  pr  
}
```

```
## create a tibble with the k and pr per k  
bday <- tibble(k = 1:50, pr = birthday(k))
```

# Birthday Problem

```
## plot (need to adjust size)
ggplot(bday, aes(x = k, y = pr)) +
  geom_line() +
  geom_point() +
  scale_y_continuous(str_c("Probability that at least two",
                           "people have the same birthday", sep = "\n"),
                    limits = c(0, 1), breaks = seq(0, 1, by = 0.1))
labs(x = "Number of people")
```



# Ph.D. Admission Problem Solution via Monte Carlo Simulation

```
## setting seed for replication
set.seed(4444)
k <- 23 # number of people
sims <- 1000 # number of simulations
event <- 0 # counter
for (i in 1:sims) {
  days <- sample(1:365, k, replace = TRUE)
  days.unique <- unique(days) # unique birthdays
  ## if there are duplicates, the number of unique birthdays
  ## will be less than the number of birthdays, which is `k'
  if (length(days.unique) < k) {
    event <- event + 1
  }
}
```

# Solution via Monte Carlo Simulation

```
## fraction of trials where at least two bdays are the same  
answer <- event / sims  
answer
```

Need to make a plot here myself. qss tidyverse p280