Contents

8.1 Analysing the Relationship Between Friends and Followers for Twitter Users

8.1.1 Retrieve the posts from Twitter

relevant posts can be retrieved from twitter by utilising the `rtweet` package, packages can be loaded for use in **R** thusly:

```
# Load Packages
 ↪  ------------------------------------------------------------
setwd("~/Dropbox/Notes/DataSci/Social_Web_Analytics/SWA-Project/scripts
 ↪  /")

if (require("pacman")) {
  library(pacman)
} else{
  install.packages("pacman")
  library(pacman)
}

pacman::p_load(xts, sp, gstat, ggplot2, rmarkdown, reshape2,
               ggmap, parallel, dplyr, plotly, tidyverse,
               reticulate, UsingR, Rmpfr, swirl, corrplot,
               gridExtra, mise, latex2exp, tree, rpart,
               lattice, coin, primes, epitools, maps, clipr,
               ggmap, twitteR, ROAuth, tm, rtweet, base64enc,
               httpuv, SnowballC, RColorBrewer, wordcloud,
               ggwordcloud, tidyverse, boot)
```

Listing 1: Load the Packages for ***R***

The `rtweet` API will search for tweets that contain all the words of a query regardless of uppercase or lowercase usage [5].

In order to leverage the *Twitter* API it is necessary to use tokens provided through a *Twitter* developer account:

```
# Set up Tokens ============================================================

options(RCurlOptions = list(
  verbose = FALSE,
  capath = system.file("CurlSSL", "cacert.pem", package = "RCurl"),
  ssl.verifypeer = FALSE
))

setup_twitter_oauth(
  consumer_key = "************************",
  consumer_secret =
  ↪ "**************************************************",
  access_token = "**************************************************",
  access_secret = "*********************************************"
)

# rtweet ===================================================================
tk <-    rtweet::create_token(
  app = "SWA",
  consumer_key    = "************************",
  consumer_secret =
  ↪ "**************************************************",
  access_token    =
  ↪ "**************************************************",
  access_secret   = "*********************************************",
  set_renv        = FALSE
```

Listing 2: Import the twitter tokens (redacted)

and hence all tweets containing a mention of *Ubisoft* can be returned and saved to disk as shown in listing 3:

8.2.2 Count of Followers and Friends

In order to identify the number of users that are contained in the *tweets* the `unique()` function can be used to return a vector of names which can then be passed as an index to the vector of counts as shown in listing 4, this provides that 81.7% of the tweets are by unique users.

```
n <- 1000
tweets.company <- search_tweets(q = 'ubisoft', n = n, token = tk,
                                include_rts = FALSE)
save(tweets.company[,], file = "resources/Download_1.Rdata")
```

Listing 3: Save the Tweets to the HDD as an rdata file

```
(users <- unique(tweets.company$name)) %>% length()
x <- tweets.company$followers_count[duplicated(tweets.company$name)]
y <- tweets.company$friends_count[duplicated(tweets.company$name)]

## > [1] 817
```

Listing 4: Return follower count of twitter posts

8.1.3 Summary Statistics

The average number of friends and followers from users who posted tweets mentioning *Ubisoft* can be returned using the `mean()` as shown in listing 5 this provides that on average each user has 586 friends and 63,620 followers.

```
x<- rnorm(090)
y<- rnorm(090)
(xbar <- mean(x))
(ybar <- mean(y))

## > [1] 4295.195
## > [1] 435.9449
```

Listing 5: Determine the average number of friends and followers

8.1.4 Above Average Followers

Each user can be compared to the average number of followers, by using a logical operator on the vector (e.g. `y > ybar`), this will return an output of logical values. ***R*** will coerce logicals into 1/0 values meaning that the mean value will return the proportion of `TRUE` responses as shown in listing 6. This provides that 20.6% of the users identified have above average friend counts, while only 2.4% have an above average numbmer of followers.

```r
(px_hat <- mean(x>xbar))
(py_hat <- mean(y>ybar))

## > [1] 0.0244798
## > [1] 0.2729498
```

Listing 6: Calculate the proportion of users with above average follower counts

8.1.5 Bootstrap confidence intervals

a.) Generate a bootsrap distribution

A bootstrap assumes that the population is an infinitely large repetition of the sample, a bootstrap of the follower counts can be produced by resampling with replacement/repetition and plotted using the `ggplot2` library as deomonstrated in listings 7 and .1 and shown in figure 1.

This shows that the population follower counts is a non-normal skew-right distribution, which is expected because the number of friends is an integer value bound by zero [6].

```r
## Resample the Data
(bt_pop <- sample(x, size = 10^6, replace = TRUE)) %>% head()

## > [1]   7 515 262 309 186 166
```

Listing 7: Bootstrapping a population from the sample.

```r
## Make the Population
bt_pop_data <- tibble("Followers" = bt_pop)
ggplot(data = bt_pop_data, aes(x = Followers)) +
  geom_histogram(aes(y = ..density..), fill = "lightblue", bins = 35,
  ↪  col = "pink") +
  geom_density(col = "violetred2") +
  scale_x_continuous(limits = c(1, 800)) +
  theme_bw() +
  labs(x = "Number of Followers", y = "Density",
       title = "Bootstrapped population of Follower Numbers")
```

b.) Estimate a Confidence Interval for Follower Counts

In order to perform a bootrap for the population mean value of follower counts it is necessary to:

1. Resample the data with replacement

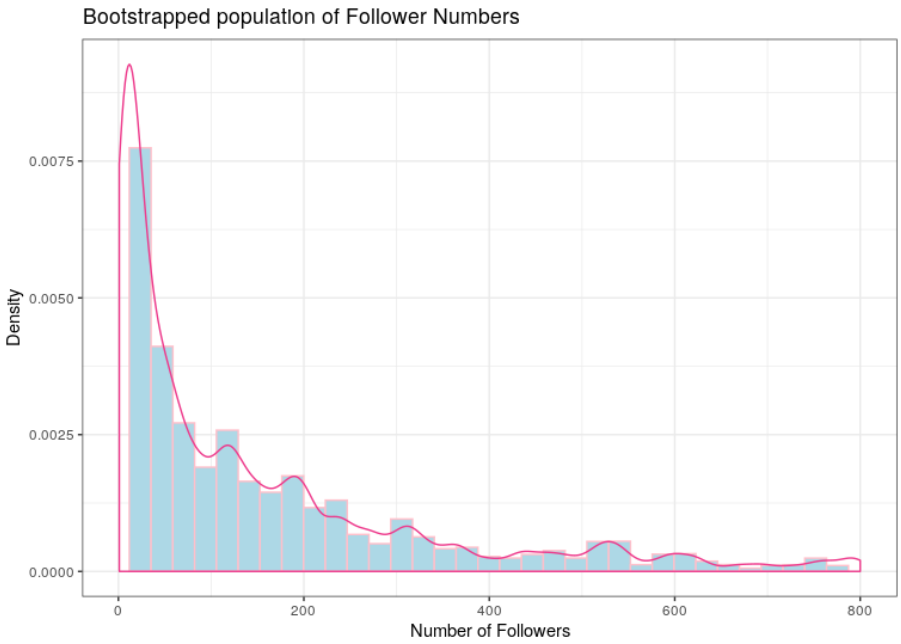

Figure 1: Histogram of the bootrapped population of follower counts

- that is randomly select values from the sample allowing for repetition

2. Measure the statistic in concern
3. Replicate this a sufficient number of times
    - Greater than or equal to 1000 times [2, Ch. 5]

This is equivalent to drawing a sample from a population that is infinitely large and constructed of repetitions of the sample. This can be performed in ***R*** as shown in listings

```
xbar_boot_loop <- replicate(10^3, {
  s <- sample(x, replace = TRUE)
  mean(s)
  })
quantile(xbar_boot_loop, c((1-0.97)/2, (1+0.97)/2))

##       1.5%      98.5%
##   588.4189 10228.7352
```

Listing 8: Confidence Interval of Mean Follower Count in Population

This provides that 97% of samples drawn from a population will contain the population mean

A 97% probability interval is such that a sample drawn from a population will contain the population mean in that interval 97% of the time, this means that it may be concluded with a high degree of certainty that the true population mean lies between 588 and 10228.

1. Alternative Approaches If this data was normally distributed it may have been appropriate to consider bootstrapping the standard error, however it is more appropriate to use a percentile interval for skewed data such as this, in saying that however this method is not considered to be very accurate in the literature and is often too narrow. [3, Section 4.1]

    - It's worth noting that the normal t value bootstrap offers no advantage over using a t distribution (other than being illustrative of bootstrapping generally) [3, Section 4.1]

    The `boot` package is a bootstrapping library common among authors in the data science sphere [4, p. 295] [8, p. 237] that implements confidence intervals consistent with work by Davison and Hinkley [7] in there texbook *Bootstrap Methods and their Application*. In this work it is provided that the BC_a method of constructing confidence intervals is superior to mere percentile methods in terms of accuracy [2, Ch. 5], a sentiment echoed in the literature. [1, 2, Ch. 5]

    Such methods can be implemented in ***R*** by passing a function to the the `boot` function as shown in listing 9.

```r
xbar_boot <- boot(data = x, statistic = mean_val, R = 10^3)
boot.ci(xbar_boot, conf = 0.97, type = "bca", index = 1)

## BOOTSTRAP CONFIDENCE INTERVAL CALCULATIONS
## Based on 1000 bootstrap replicates
##
## CALL :
## boot.ci(boot.out = xbar_boot, conf = 0.97, type = "bca", index = 1)
##
## Intervals :
## Level       BCa
## 97%   ( 1079, 16227 )
## Calculations and Intervals on Original Scale
## Warning : BCa Intervals used Extreme Quantiles
## Some BCa intervals may be unstable
## Warning message:
## In norm.inter(t, adj.alpha) : extreme order statistics used as
↪  endpoints
```

Listing 9: Bootstrap of population mean follower count implementing the BC_a method

references

References

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