

Twitter Data Analysis with R – Text Mining and Social Network Analysis ¹

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<http://www.RDataMining.com>

Short Course on R and Data Mining
University of Canberra

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¹Chapter 10: Text Mining, in *R and Data Mining: Examples and Case Studies*.

Outline

Introduction

Tweets Analysis

- Extracting Tweets

- Text Cleaning

- Frequent Words and Word Cloud

- Word Associations

- Topic Modelling

- Sentiment Analysis

Followers and Retweeting Analysis

- Follower Analysis

- Retweeting Analysis

R Packages

References and Online Resources

Twitter



- ▶ An online social networking service that enables users to send and read short 140-character messages called “tweets” (Wikipedia)
- ▶ Over 300 million monthly active users (as of 2015)
- ▶ Creating over 500 million tweets per day

RDataMining Twitter Account

 **Yanchang Zhao**
@RDataMining

TWEETS
583

FOLLOWING
72

FOLLOWERS
2,376

LIKES
6

@RDataMining

R and Data Mining. Group on LinkedIn:
group.rdatamining.com

 Australia

 RDataMining.com

 Joined April 2011

 Photos and videos



Yanchang Zhao @RDataMining · Feb 9

A Twitter dataset for text mining:
[@RDataMining](https://twitter.com/RDataMining) Tweets extracted on 3
February 2016. Download it at
rdatamining.com/data



14



13



Yanchang Zhao Retweeted



Canberra Data Sci @CanberraDataSci · Jan 28

Join Canberra Data Scientists seminar on Cyberbullying Detection,
4:30pm, Tuesday 2 Feb meetup.com/CanberraDataSci...



1



[View summary](#)



Yanchang Zhao @RDataMining · 30 Dec 2015

Vacancy of Data Scientist – Healthcare Analytics, Adelaide, Australia
seek.com.au/Job/30084590?_...



1



2



- ▶ @RDataMining: focuses on R and Data Mining
- ▶ 600+ tweets/retweets (as of October 2016)
- ▶ 2,700+ followers

Techniques and Tools

- ▶ Techniques
 - ▶ Text mining
 - ▶ Topic modelling
 - ▶ Sentiment analysis
 - ▶ Social network analysis
- ▶ Tools
 - ▶ Twitter API
 - ▶ R and its packages:
 - ▶ *twitteR*
 - ▶ *tm*
 - ▶ *topicmodels*
 - ▶ *sentiment140*
 - ▶ *igraph*

Process

1. Extract tweets and followers from the Twitter website with R and the *twitteR* package
2. With the *tm* package, clean text by removing punctuations, numbers, hyperlinks and stop words, followed by stemming and stem completion
3. Build a term-document matrix
4. Analyse topics with the *topicmodels* package
5. Analyse sentiment with the *sentiment140* package
6. Analyse following/followed and retweeting relationships with the *igraph* package

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Retrieve Tweets

```
## Option 1: retrieve tweets from Twitter
library(twitteR)
library(ROAuth)
## Twitter authentication
setup_twitter_oauth(consumer_key, consumer_secret, access_token,
  access_secret)
## 3200 is the maximum to retrieve
tweets <- userTimeline("RDataMining", n = 3200)
```

```
## Option 2: download @RDataMining tweets from RDataMining.com
url <- "http://www.rdatamining.com/data/RDataMining-Tweets-20160212.rds"
download.file(url, destfile = "./data/RDataMining-Tweets-20160212.rds")
## load tweets into R
tweets <- readRDS("./data/RDataMining-Tweets-20160212.rds")
```

Twitter Authentication with OAuth:

Section 3 of <http://geoffjentry.hexdump.org/twitteR.pdf>


```

(n.tweet <- length(tweets))

## [1] 448

# convert tweets to a data frame
tweets.df <- twListToDF(tweets)
# tweet #190
tweets.df[190, c("id", "created", "screenName", "replyToSN",
  "favoriteCount", "retweetCount", "longitude", "latitude", "text")]

##              id              created screenName re...
## 190 362866933894352898 2013-08-01 09:26:33 RDataMining ...
##      favoriteCount retweetCount longitude latitude
## 190              9              9          NA          NA
##
## ...
## 190 The R Reference Card for Data Mining now provides lin...

# print tweet #190 and make text fit for slide width
writeLines(strwrap(tweets.df$text[190], 60))

## The R Reference Card for Data Mining now provides links to
## packages on CRAN. Packages for MapReduce and Hadoop added.
## http://t.co/RrFypol8kw

```

Text Cleaning

```
library(tm)
# build a corpus, and specify the source to be character vectors
myCorpus <- Corpus(VectorSource(tweets.df$text))
# convert to lower case
myCorpus <- tm_map(myCorpus, content_transformer(tolower))
# remove URLs
removeURL <- function(x) gsub("http[^\s:]*", "", x)
myCorpus <- tm_map(myCorpus, content_transformer(removeURL))
# remove anything other than English letters or space
removeNumPunct <- function(x) gsub("[^\p{L} \p{N} \p{P} \p{S} \p{Z}]*", "", x)
myCorpus <- tm_map(myCorpus, content_transformer(removeNumPunct))
# remove stopwords
myStopwords <- c(setdiff(stopwords('english'), c("r", "big")),
                  "use", "see", "used", "via", "amp")
myCorpus <- tm_map(myCorpus, removeWords, myStopwords)
# remove extra whitespace
myCorpus <- tm_map(myCorpus, stripWhitespace)

# keep a copy for stem completion later
myCorpusCopy <- myCorpus
```

Stemming and Stem Completion ²

```
myCorpus <- tm_map(myCorpus, stemDocument) # stem words
writeLines(strwrap(myCorpus[[190]]$content, 60))

## r refer card data mine now provid link packag cran packag
## mapredc hadoop ad

stemCompletion2 <- function(x, dictionary) {
  x <- unlist(strsplit(as.character(x), " "))
  x <- x[x != ""]
  x <- stemCompletion(x, dictionary=dictionary)
  x <- paste(x, sep=" ", collapse=" ")
  PlainTextDocument(stripWhitespace(x))
}

myCorpus <- lapply(myCorpus, stemCompletion2, dictionary=myCorpusCopy)
myCorpus <- Corpus(VectorSource(myCorpus))
writeLines(strwrap(myCorpus[[190]]$content, 60))

## r reference card data miner now provided link package cran
## package mapreduce hadoop add
```

²<http://stackoverflow.com/questions/25206049/stemcompletion-is-not-working>

Issues in Stem Completion: “Miner” vs “Mining”

```
# count word frequency
wordFreq <- function(corpus, word) {
  results <- lapply(corpus,
    function(x) { grep(as.character(x), pattern=paste0("\\<",word)) }
  )
  sum(unlist(results))
}

n.miner <- wordFreq(myCorpusCopy, "miner")
n.mining <- wordFreq(myCorpusCopy, "mining")
cat(n.miner, n.mining)

## 9 104

# replace oldword with newword
replaceWord <- function(corpus, oldword, newword) {
  tm_map(corpus, content_transformer(gsub),
    pattern=oldword, replacement=newword)
}

myCorpus <- replaceWord(myCorpus, "miner", "mining")
myCorpus <- replaceWord(myCorpus, "universidad", "university")
myCorpus <- replaceWord(myCorpus, "scienc", "science")
```

Build Term Document Matrix

```
tdm <- TermDocumentMatrix(myCorpus,  
                           control = list(wordLengths = c(1, Inf)))  
tdm  
  
## <TermDocumentMatrix (terms: 1073, documents: 448)>  
## Non-/sparse entries: 3594/477110  
## Sparsity           : 99%  
## Maximal term length: 23  
## Weighting           : term frequency (tf)  
  
idx <- which(dimnames(tdm)$Terms %in% c("r", "data", "mining"))  
as.matrix(tdm[idx, 21:30])  
  
##           Docs  
## Terms      21 22 23 24 25 26 27 28 29 30  
## data       0  1  0  0  1  0  0  0  0  1  
## mining     0  0  0  0  1  0  0  0  0  1  
## r          1  1  1  1  0  1  0  1  1  1
```

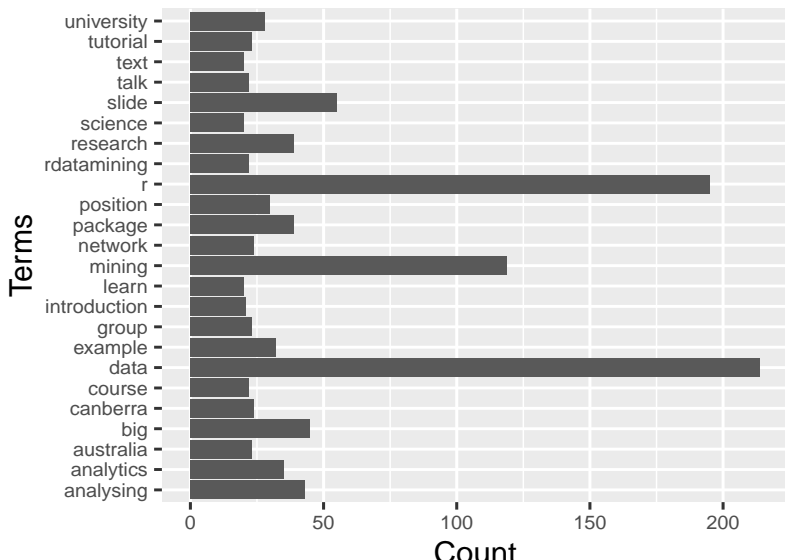
Top Frequent Terms

```
# inspect frequent words
(freq.terms <- findFreqTerms(tdm, lowfreq = 20))

## [1] "analysing"      "analytics"      "australia"      "big"
## [5] "canberra"       "course"         "data"           "example"
## [9] "group"          "introduction"   "learn"          "mining"
## [13] "network"        "package"        "position"       "r"
## [17] "rdatamining"    "research"       "science"        "slide"
## [21] "talk"           "text"           "tutorial"       "university"

term.freq <- rowSums(as.matrix(tdm))
term.freq <- subset(term.freq, term.freq >= 20)
df <- data.frame(term = names(term.freq), freq = term.freq)
```

```
library(ggplot2)
ggplot(df, aes(x=term, y=freq)) + geom_bar(stat="identity") +
  xlab("Terms") + ylab("Count") + coord_flip() +
  theme(axis.text=element_text(size=7))
```



Wordcloud

```
m <- as.matrix(tdm)
# calculate the frequency of words and sort it by frequency
word.freq <- sort(rowSums(m), decreasing = T)
# colors
pal <- brewer.pal(9, "BuGn")[-(1:4)]

# plot word cloud
library(wordcloud)
wordcloud(words = names(word.freq), freq = word.freq, min.freq = 3,
          random.order = F, colors = pal)
```


Associations

```
# which words are associated with 'r'?
```

```
findAssocs(tdm, "r", 0.2)
```

```
##           r
## code      0.27
## example   0.21
## series    0.21
## markdown  0.20
## user      0.20
```

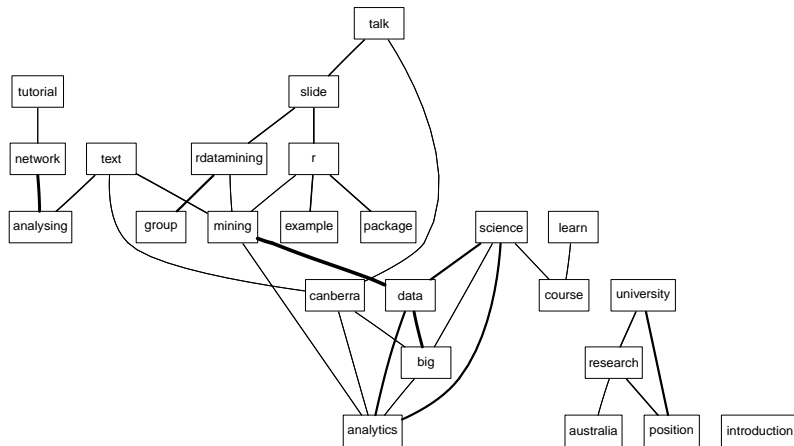
```
# which words are associated with 'data'?
```

```
findAssocs(tdm, "data", 0.2)
```

```
##           data
## mining      0.48
## big         0.44
## analytics   0.31
## science     0.29
## poll        0.24
```

Network of Terms

```
library(graph)
library(Rgraphviz)
plot(tdm, term = freq.terms, corThreshold = 0.1, weighting = T)
```



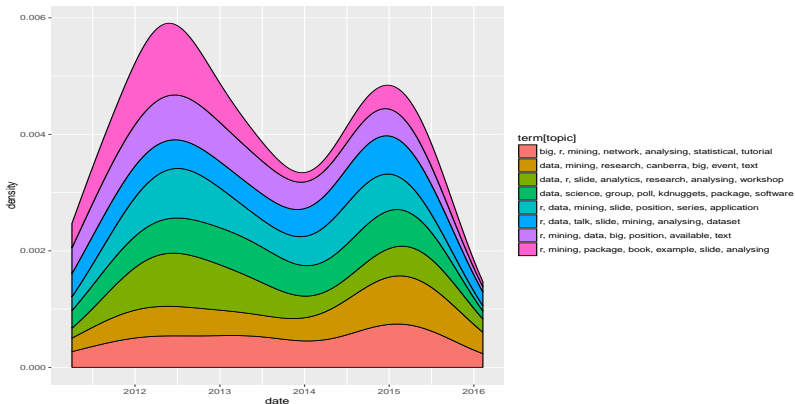
Topic Modelling

```
dtm <- as.DocumentTermMatrix(tdm)
library(topicmodels)
lda <- LDA(dtm, k = 8) # find 8 topics
term <- terms(lda, 7) # first 7 terms of every topic
(term <- apply(term, MARGIN = 2, paste, collapse = ", "))

##                                     Topic 1
##      "r, data, mining, slide, position, series, application"
##                                     Topic 2
##      "r, mining, data, big, position, available, text"
##                                     Topic 3
##      "data, science, group, poll, kdnuggets, package, software"
##                                     Topic 4
##      "r, data, talk, slide, mining, analysing, dataset"
##                                     Topic 5
##      "r, mining, package, book, example, slide, analysing"
##                                     Topic 6
##      "big, r, mining, network, analysing, statistical, tutorial"
##                                     Topic 7
##      "data, r, slide, analytics, research, analysing, workshop"
##                                     Topic 8
##      "data, mining, research, canberra, big, event, text"
```

Topic Modelling

```
topics <- topics(lda) # 1st topic identified for every document (tweet)
topics <- data.frame(date=as.IDate(tweets.df$created), topic=topics)
ggplot(topics, aes(date, fill = term[topic])) +
  geom_density(position = "stack")
```



Another way to plot steam graph:

<http://menugget.blogspot.com.au/2013/12/data-mountains-and-streams-stacked-area.html>

Sentiment Analysis

```
# install package sentiment140
require(devtools)
install_github("sentiment140", "okugami79")
```

```
# sentiment analysis
library(sentiment)
sentiments <- sentiment(tweets.df$text)
table(sentiments$polarity)
```

```
##
##  neutral  positive
##      428       20
```

```
# sentiment plot
sentiments$score <- 0
sentiments$score[sentiments$polarity == "positive"] <- 1
sentiments$score[sentiments$polarity == "negative"] <- -1
sentiments$date <- as.IDate(tweets.df$created)
result <- aggregate(score ~ date, data = sentiments, sum)
plot(result, type = "l")
```

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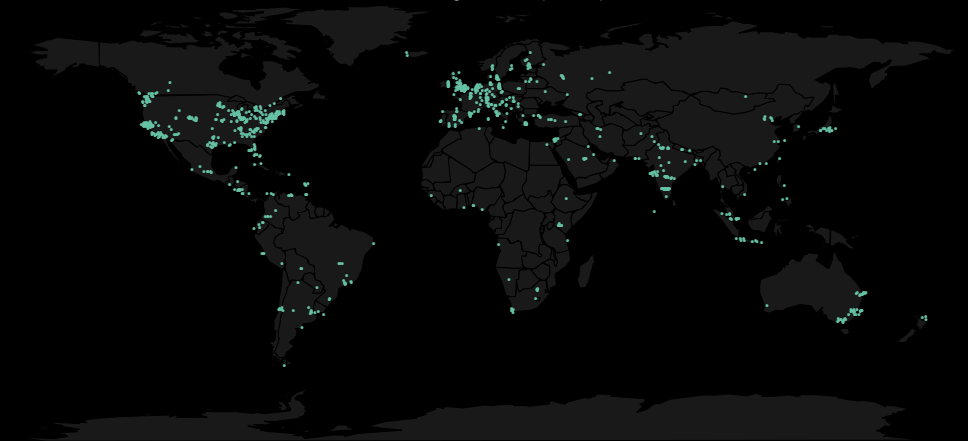
Retrieve User Info and Followers

```
user <- getUser("RDataMining")
user$toDataFrame()
friends <- user$getFriends() # who this user follows
followers <- user$getFollowers() # this user's followers
followers2 <- followers[[1]]$getFollowers() # a follower's followers
```

```
##           [,1]           ...
## description "R and Data Mining. Group on LinkedIn: ...
## statusesCount "583"           ...
## followersCount "2376"          ...
## favoritesCount "6"             ...
## friendsCount   "72"            ...
## url            "http://t.co/LwL50uRmPd"          ...
## name           "Yanchang Zhao"          ...
## created        "2011-04-04 09:15:43"          ...
## protected      "FALSE"           ...
## verified       "FALSE"           ...
## screenName     "RDataMining"         ...
## location       "Australia"          ...
## lang           "en"               ...
## id             "276895537"          ...
## linkId         "157"              ...
```

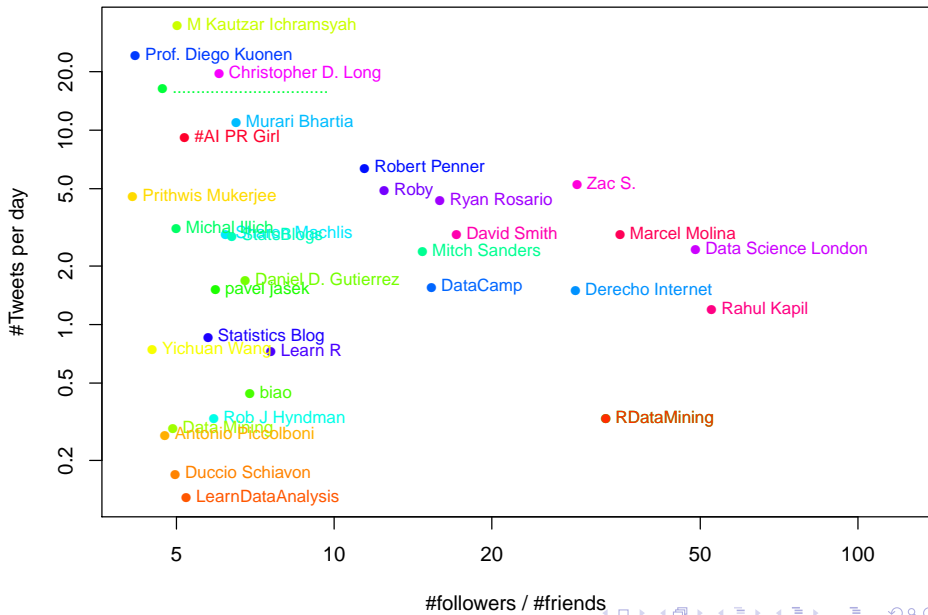

Follower Map³

@RDataMining Followers (#: 2376)



³Based on Jeff Leek's twitterMap function at
<http://biostat.jhsph.edu/~jleek/code/twitterMap.R>

Active Influential Followers

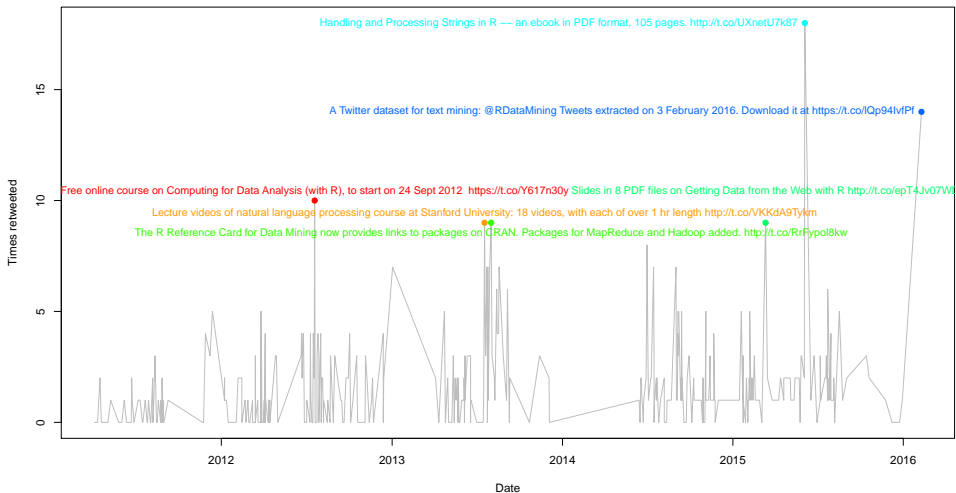


Top Retweeted Tweets

```
# select top retweeted tweets
table(tweets.df$retweetCount)
selected <- which(tweets.df$retweetCount >= 9)

# plot them
dates <- strptime(tweets.df$created, format="%Y-%m-%d")
plot(x=dates, y=tweets.df$retweetCount, type="l", col="grey",
     xlab="Date", ylab="Times retweeted")
colors <- rainbow(10)[1:length(selected)]
points(dates[selected], tweets.df$retweetCount[selected],
       pch=19, col=colors)
text(dates[selected], tweets.df$retweetCount[selected],
     tweets.df$text[selected], col=colors, cex=.9)
```

Top Retweeted Tweets



Tracking Message Propagation

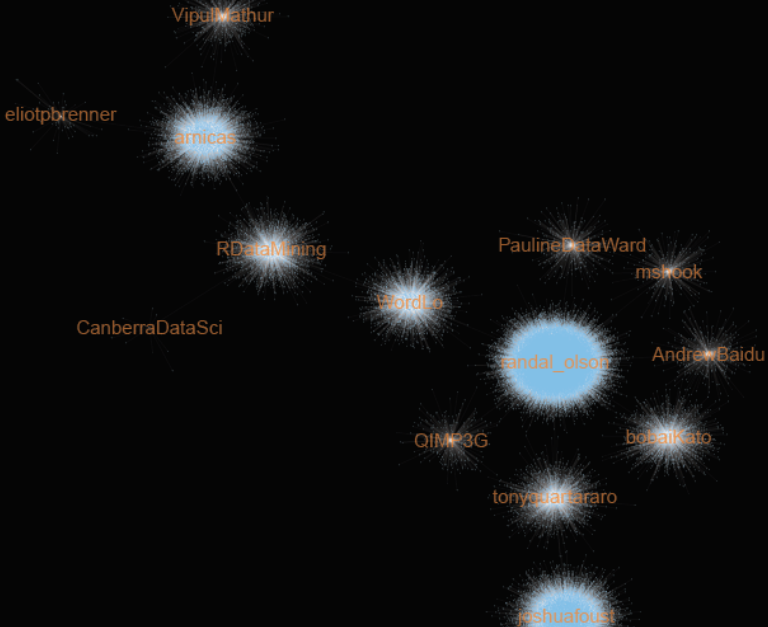
```
tweets[[1]]  
retweeters(tweets[[1]]$id)  
retweets(tweets[[1]]$id)
```

```
## [1] "RDataMining: A Twitter dataset for text mining: @RDa..."
```

```
## [1] "197489286" "316875164" "229796464" "3316009302"  
## [5] "244077734" "16900353" "2404767650" "222061895"  
## [9] "11686382" "190569306" "49413866" "187048879"  
## [13] "6146692" "2591996912"
```

```
## [[1]]  
## [1] "bobaiKato: RT @RDataMining: A Twitter dataset for te...  
##  
## [[2]]  
## [1] "VipulMathur: RT @RDataMining: A Twitter dataset for ...  
##  
## [[3]]  
## [1] "tau_phoenix: RT @RDataMining: A Twitter dataset for ...
```

The tweet potentially reached around 120,000 users.



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R Packages

- ▶ Twitter data extraction: *twitteR*
- ▶ Text cleaning and mining: *tm*
- ▶ Word cloud: *wordcloud*
- ▶ Topic modelling: *topicmodels*, *lda*
- ▶ Sentiment analysis: *sentiment140*
- ▶ Social network analysis: *igraph*, *sna*
- ▶ Visualisation: *wordcloud*, *Rgraphviz*, *ggplot2*

Twitter Data Extraction – Package *twitteR* ⁴

- ▶ `userTimeline`, `homeTimeline`, `mentions`, `retweetsOfMe`: retrieve various timelines
- ▶ `getUser`, `lookupUsers`: get information of Twitter user(s)
- ▶ `getFollowers`, `getFollowerIDs`: retrieve followers (or their IDs)
- ▶ `getFriends`, `getFriendIDs`: return a list of Twitter users (or user IDs) that a user follows
- ▶ `retweets`, `retweeters`: return retweets or users who retweeted a tweet
- ▶ `searchTwitter`: issue a search of Twitter
- ▶ `getCurRateLimitInfo`: retrieve current rate limit information
- ▶ `twListToDF`: convert into `data.frame`

⁴<https://cran.r-project.org/package=twitteR>

Text Mining – Package *tm*⁵

- ▶ `removeNumbers`, `removePunctuation`, `removeWords`, `removeSparseTerms`, `stripWhitespace`: remove numbers, punctuations, words or extra whitespaces
- ▶ `removeSparseTerms`: remove sparse terms from a term-document matrix
- ▶ `stopwords`: various kinds of stopwords
- ▶ `stemDocument`, `stemCompletion`: stem words and complete stems
- ▶ `TermDocumentMatrix`, `DocumentTermMatrix`: build a term-document matrix or a document-term matrix
- ▶ `termFreq`: generate a term frequency vector
- ▶ `findFreqTerms`, `findAssocs`: find frequent terms or associations of terms
- ▶ `weightBin`, `weightTf`, `weightTfIdf`, `weightSMART`, `WeightFunction`: various ways to weight a term-document matrix

⁵<https://cran.r-project.org/package=tm>

Topic Modelling and Sentiment Analysis – Packages *topicmodels* & *sentiment140*

Package *topicmodels* ⁶

- ▶ LDA: build a Latent Dirichlet Allocation (LDA) model
- ▶ CTM: build a Correlated Topic Model (CTM) model
- ▶ terms: extract the most likely terms for each topic
- ▶ topics: extract the most likely topics for each document

Package *sentiment140* ⁷

- ▶ sentiment: sentiment analysis with the sentiment140 API, tune to Twitter text analysis

⁶<https://cran.r-project.org/package=topicmodels>

⁷<https://github.com/okugami79/sentiment140>

Social Network Analysis and Visualization – Package *igraph*⁸

- ▶ `degree`, `betweenness`, `closeness`, `transitivity`: various centrality scores
- ▶ `neighborhood`: neighborhood of graph vertices
- ▶ `cliques`, `largest.cliques`, `maximal.cliques`, `clique.number`: find cliques, ie. complete subgraphs
- ▶ `clusters`, `no.clusters`: maximal connected components of a graph and the number of them
- ▶ `fastgreedy.community`, `spinglass.community`: community detection
- ▶ `cohesive.blocks`: calculate cohesive blocks
- ▶ `induced.subgraph`: create a subgraph of a graph (`igraph`)
- ▶ `read.graph`, `write.graph`: read and writ graphs from and to files of various formats

⁸<https://cran.r-project.org/package=igraph>

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References

- ▶ Yanchang Zhao. *R and Data Mining: Examples and Case Studies*. ISBN 978-0-12-396963-7, December 2012. Academic Press, Elsevier. 256 pages.
<http://www.rdatamining.com/docs/RDataMining-book.pdf>
- ▶ Yanchang Zhao and Yonghua Cen (Eds.). *Data Mining Applications with R*. ISBN 978-0124115118, December 2013. Academic Press, Elsevier.
- ▶ Yanchang Zhao. Analysing Twitter Data with Text Mining and Social Network Analysis. In *Proc. of the 11th Australasian Data Mining Analytics Conference (AusDM 2013)*, Canberra, Australia, November 13-15, 2013.

Online Resources

- ▶ Chapter 10 – Text Mining & Chapter 11 – Social Network Analysis, in book *R and Data Mining: Examples and Case Studies*

<http://www.rdatamining.com/docs/RDataMining.pdf>

- ▶ RDataMining Reference Card

<http://www.rdatamining.com/docs/RDataMining-reference-card.pdf>

- ▶ Online documents, books and tutorials

<http://www.rdatamining.com/resources/onlinedocs>

- ▶ Free online courses

<http://www.rdatamining.com/resources/courses>

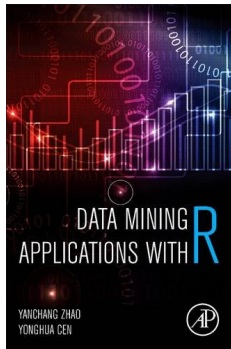
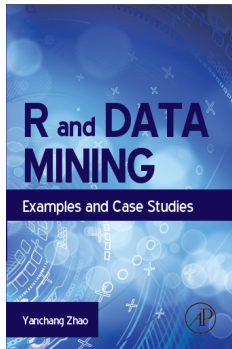
- ▶ RDataMining Group on LinkedIn (22,000+ members)

<http://group.rdatamining.com>

- ▶ Twitter (2,700+ followers)

@RDataMining

The End



Thanks!

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Twitter: @RDataMining