MDS503

8016013

2024-06-27

6

```
##--------

library(igraph)
```

```
## Warning: package 'igraph' was built under R version 4.3.3
```

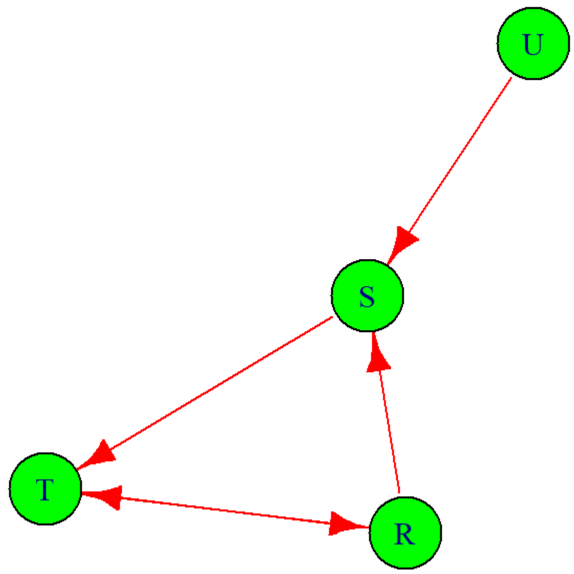
```
##
## Attaching package: 'igraph'
```

```
## The following objects are masked from 'package:stats':
##
##     decompose, spectrum
```

```
## The following object is masked from 'package:base':
##
##     union
```

```
#a
#Defining a graph object
g1<-graph(c("R","S","S","T","T","R","R","T","U","S"))

#b
plot(g1,vertex.color="green",vertex.size=30,edge.color="red",edge.size=5)
```




```
#this graph represent the relation between various nodes

#c
degree(g1)
```

```
## R S T U
## 3 3 3 1
```

```
#degree states that how many relations a single node is holding then
#from the result we see that R,S,T have 3 relations but U has only one relation

closeness(g1)
```

```
##         R         S         T         U
## 0.5000000 0.3333333 0.3333333 0.1666667
```

```
#closeness of the nodes is how close the node is with the other nodes

betweenness(g1) #it gives how many nodes have the relation with that node
```

```
## R S T U
## 1 2 2 0
```

```
#here S has 2 betweenness that means 2 nodes have relation with S

#d
# Identify hubs in the graph
hubs <- which(degree(g1) == max(degree(g1)))
hubs
```

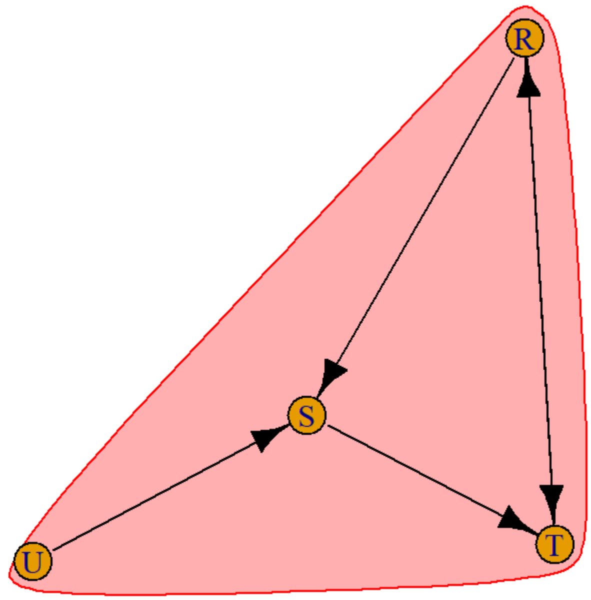
```
## R S T
## 1 2 3
```

```
#Hubs in a graph refer to nodes with high connectivity or degree that
# serve as central points of the network.

# Find communities in the graph
communities <- cluster_walktrap(g1)
cat("Number of communities: ", length(communities), "\n")
```

```
## Number of communities:  1
```

```
# Visualize the graph with communities highlighted
plot(communities, g1)
```




```
#Communities in a graph represent groups of nodes that are more densely connected
#within the group compared to connections between groups
```

7

```
# a
getwd()
```

```
## [1] "C:/Users/kaush/Desktop/8016013"
```

```
library(pdftools)
```

```
## Warning: package 'pdftools' was built under R version 4.3.3
```

```
## Using poppler version 23.08.0
```

```
library(tm)
```

```
## Warning: package 'tm' was built under R version 4.3.3
```

```
## Loading required package: NLP
```

```
library(wordcloud)
```

```
## Warning: package 'wordcloud' was built under R version 4.3.3
```

```
## Loading required package: RColorBrewer
```

```
library(RColorBrewer)
library(topicmodels)
```

```
## Warning: package 'topicmodels' was built under R version 4.3.3
```

```
# a
getwd()
```

```
## [1] "C:/Users/kaush/Desktop/8016013"
```

```
# Specify the path to your PDF file
#Question b
pdf_file <- "R-intro.pdf"


library(tm)
#Question c
# Extract text from PDF using pdftools
pdf_text <- pdf_text(pdf_file)

# Convert the text into a corpus using tm package
corpus <- Corpus(VectorSource(pdf_text))

# Preprocessing: Convert to lower case, remove numbers and punctuation
corpus <- tm_map(corpus, content_transformer(tolower))
```

```
## Warning in tm_map.SimpleCorpus(corpus, content_transformer(tolower)):
## transformation drops documents
```

```
corpus <- tm_map(corpus, removeNumbers)
```

```
## Warning in tm_map.SimpleCorpus(corpus, removeNumbers): transformation drops
## documents
```

```
corpus <- tm_map(corpus, removePunctuation)
```

```
## Warning in tm_map.SimpleCorpus(corpus, removePunctuation): transformation drops
## documents
```

```
corpus <- tm_map(corpus, removeWords, stopwords("en"))  # Remove English stopwords
```

```
## Warning in tm_map.SimpleCorpus(corpus, removeWords, stopwords("en")):
## transformation drops documents
```

```
# Strip whitespace
corpus <- tm_map(corpus, stripWhitespace)
```

```
## Warning in tm_map.SimpleCorpus(corpus, stripWhitespace): transformation drops
## documents
```

```
corpus<-tm_map(corpus,stemDocument)
```

```
## Warning in tm_map.SimpleCorpus(corpus, stemDocument): transformation drops
## documents
```

```
#Question d
# Create Document Term Matrix
myTdm<- TermDocumentMatrix(corpus,control = list(wordLengths=c(1,Inf)))


# Get term frequencies
(freq.terms<-findFreqTerms(myTdm,lowfreq = 150))
```

```
##  [1] "data"     "r"        "function" "use"      "valu"     "vector"
##  [7] "model"    "plot"     "can"      "x"        "y"
```

```
# Subset term frequencies for most frequent terms
m<-as.matrix(myTdm)
# Sort frequencies in descending order
(freq<-sort(rowSums(m),decreasing = T))
```

```
##                                   function                                use
##                                        420                                397
##                                          r                             vector
##                                        363                                254
##                                          x                                can
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##                                       data                               plot
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##                                     5                                5
##                               earlier                             rest
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##                              approxim                               ld
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##                                height                           button
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##                             noenviron                         norestor
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##                                 nosav                           rguiex
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##                               vanilla                           insert
##                                     5                                5
##                                 smith                           divert
##                                     4                                4
##                          introductori                           sensit
##                                     4                                4
##                               softwar                           partit
##                                     4                                4
##                             contribut                         mathemat
##                                     4                                4
##                             multivari                      nonstandard
##                                     4                                4
##                                    iv                              faq
##                                     4                                4
##                              hardcopi                            hasti
##                                     4                                4
##                               mention                           regard
##                                     4                                4
##                              techniqu                            think
##                                     4                                4
##                                   ask                             easi
##                                     4                                4
##                                expert                             guid
##                                     4                                4
```

```
##                    occasion                      seek
##                           4                         4
##                       shall                     escap
##                           4                         4
##                        html                       man
##                           4                         4
##                       arrow                      byte
##                           4                         4
##                     forward                  keyboard
##                           4                         4
##                          ls                      menu
##                           4                         4
##                      record                      hard
##                           4                         4
##                          cx                         ”
##                           4                         4
##                         exp                   lengthx
##                           4                         4
##                     neither                     power
##                           4                         4
##                        sort                       var
##                           4                         4
##                         ind                      kind
##                           4                         4
##                      append                      evid
##                           4                         4
##                        past                       sub
##                           4                         4
##                        fact                  coercion
##                           4                         4
##                        care                   certain
##                           4                         4
##                      former                       old
##                           4                         4
##                      outsid                      rare
##                           4                         4
##                   australia                 territori
##                           4                         4
##                          sd                    someth
##                           4                         4
##                      confus                      dimz
##                           4                         4
##                       ignor                    doubli
##                           4                         4
##                          xi                      cosi
##                           4                         4
##                      random                      rank
##                           4                         4
##                     uniform                      diag
##                           4                         4
##                     smaller                        xt
##                           4                         4
```

```
##          absolut         diagnost
##                4                4
##          eigensm            lsfit
##                4                4
##             leav         autoload
##                4                4
##        globalenv             util
##                4                4
##    usercontribut            gamma
##                4                4
##             logi    loglikelihood
##                4                4
##            shape         wilcoxon
##                4                4
##                ≤               rd
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##           smooth     dopointsfals
##                4                4
##               qq     verticalstru
##                4                4
##           aspect             stat
##                4                4
##           higher          distanc
##                4                4
##           compil        backslash
##                4                4
##             bodi             fund
##                4                4
##            graph         graphtru
##                4                4
##             exit            divid
##                4                4
##               sq         behavior
##                4                4
##             coef        transform
##                4                4
##               op            slope
##                4                4
##           finish               mm
##                4                4
##          predict         influenc
##                4                4
##  quasilikelihood                φ
##                4                4
##            blind          kalytho
##                4                4
##            logit           probit
##                4                4
##          success            optim
##                4                4
##             yfit        highlight
##                4                4
```

```
##                                    treebas                            quartz
##                                          4                                 4
##                                   contourx                           pointer
##                                          4                                 4
##                                     layout                           convert
##                                          4                                 4
##                                      ensur                              jpeg
##                                          4                                 4
##                                        png                              usag
##                                          4                                 4
##                                        ose                          windows’
##                                          4                                 4
##                                      check                             circl
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##                                    rtermex                         nositefil
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##                                     debugg                                 g
##                                          4                                 4
##                                         mb                             latex
##                                          4                                 4
##                                      sweav                              hall
##                                          4                                 4
##                                       york                              core
##                                          4                                 3
##                                       team                           preserv
##                                          3                                 3
##                                    content                           intrins
##                                          3                                 3
##                                        rag                            archiv
##                                          3                                 3
##                                 comparison                              come
##                                          3                                 3
##                                    comment                             allan
##                                          3                                 3
##                                     becker                             built
##                                          3                                 3
##                                      coher                              inde
##                                          3                                 3
##                                 methodolog                              suit
##                                          3                                 3
##                                       wilk                           abbrevi
##                                          3                                 3
##                                   advantag                               box
##                                          3                                 3
##                                         cd                            receiv
##                                          3                                 3
##                                        yes                        elementari
##                                          3                                 3
##                                     enclos                        helpsearch
##                                          3                                 3
##                                    inbuilt                             invis
##                                          3                                 3
```

```
##           lost          proceed
##              3                3
##         strong          syntact
##              3                3
##     understand          anywher
##              3                3
##       backward          discard
##              3                3
##           emac             sink
##              3                3
##          speak           analys
##              3                3
##            bar              rmx
##              3                3
##        thought            colon
##              3                3
##         covari          increas
##              3                3
##       independ          largest
##              3                3
##       parallel           permut
##              3                3
##      incomplet           realli
##              3                3
##       distinct             join
##              3                3
##         xisnax          categor
##              3                3
##          unlik               yy
##              3                3
##      treatment            along
##              3                3
##          alpha          convers
##              3                3
##        exercis      temporarili
##              3                3
##            tax        irregular
##              3                3
##             ca             dimc
##              3                3
##             xv           extrem
##              3                3
##       artifici         ycoordin
##              3                3
##      crossprod           matlab
##              3                3
##           seem              xxt
##              3                3
##           eval              qrx
##              3                3
##         dimnam           status
##              3                3
```

```
##                        incomef                          statefr
##                              3                                3
##                         especi                          lstname
##                              3                                3
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##                              3                                3
##                     packagebas                             area
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##                       centheat                           export
##                              3                                3
##                           forc                           presum
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##                           xnew                             xold
##                              3                                3
##                          cumul                           deviat
##                              3                                3
##                           dxxx                           logist
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##                      lowertail                             prob
##                              3                                3
##                          simul                             tail
##                              3                                3
##                             bw                             good
##                              3                                3
##                           stem                            empir
##                              3                                3
##                          erupt                           linesx
##                              3                                3
##                         parpti                           reason
##                              3                                3
##                             us                          qqlinex
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##                    shapirowilk                          percent
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##                       signific                             tend
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##                         lattic                        parenthes
##                              3                                3
##                         versus                               yb
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##                          choos                     functiondata
##                              3                                3
##                            job                             turn
##                              3                                3
```

```
##                     attr                difficult
##                        3                        3
##                       r-                   safeti
##                        3                        3
##                   answer                integrand
##                        3                        3
##                 interest                    activ
##                        3                        3
##                    lexic                  deposit
##                        3                        3
##              openaccount                   person
##                        3                        3
##                 accommod                      aov
##                        3                        3
##                   summar                    degre
##                        3                        3
##                 polynomi                       xp
##                        3                        3
##                       yx                      abc
##                        3                        3
##                    whole                 descript
##                        3                        3
##              fittedmodel                 updatefm
##                        3                        3
##                   dobson                    infer
##                        3                        3
##                  practic                predictor
##                        3                        3
##                 stimulus                        .
##                        3                        3
##                     glmi                     male
##                        3                        3
##                    quasi               superimpos
##                        3                        3
##                       se                ssmicmenx
##                        3                        3
##                    loess                     nlme
##                        3                        3
##                  outlier                imaginari
##                        3                        3
##                 maintain                    histx
##                        3                        3
##                    score                    third
##                        3                        3
##                   colour                 dotchart
##                        3                        3
##                   imagex                   surfac
##                        3                        3
##                    typen                  polygon
##                        3                        3
##                    textx                     near
##                        3                        3
```

```
##                                     oldpar                           paroldpar
##                                          3                                   3
##                                   unfortun                                 tck
##                                          3                                   3
##                                       inch                              mfrowc
##                                          3                                   3
##                                        omi                               reduc
##                                          3                                   3
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##                                     memori                           packages”
##                                          3                                   3
##                                    prevent                             retriev
##                                          3                                   3
##                                         cp                                 map
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##                                       port                                rapp
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##                                       rgui                               drive
##                                          3                                   3
##                                     recent                           summaryfm
##                                          3                                   3
##                                       expt                               light
##                                          3                                   3
##                                      speed                            renviron
##                                          3                                   3
##                                   frontend                         metacharact
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##                                     assert                      commandargstru
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##                                      enabl                               quiet
##                                          3                                   3
##                                   redirect                            configur
##                                          3                                   3
##                                  emacsstyl                                  pl
##                                          3                                   3
##                                     runfoo                                 esc
##                                          3                                   3
##                                        gnu                            resubmit
##                                          3                                   3
##                                        ret                                  cf
##                                          3                                   3
##                                    chapman                              london
##                                          3                                   3
##                                      deriv                            translat
##                                          2                                   2
##                                   verbatim                              prefac
##                                          2                                   2
##                                      manag                             repetit
##                                          2                                   2
```

```
##                diagram            typeset
##                      2                  2
##                   bill              david
##                      2                  2
##                 materi             preced
##                      2                  2
##                univers               wait
##                      2                  2
##                 welcom               basi
##                      2                  2
##              character              cover
##                      2                  2
##               elsewher            essenti
##                      2                  2
##              increment             inflex
##                      2                  2
##              intermedi           internet
##                      2                  2
##                   piec             releas
##                      2                  2
##                richard             storag
##                      2                  2
##                 trevor                yet
##                      2                  2
##                    ‘s’         “standard”
##                      2                  2
##                 adjust                aim
##                      2                  2
##                  bring             cancel
##                      2                  2
##                  click           customiz
##                      2                  2
##                 folder             launch
##                      2                  2
##                 machin              mkdir
##                      2                  2
##                   noth              occas
##                      2                  2
##                   seri           shortcut
##                      2                  2
##        straightforward       subdirectori
##                      2                  2
##               workstat         alphanumer
##                      2                  2
##                browser            countri
##                      2                  2
##                  offer               plus
##                      2                  2
##                request             though
##                      2                  2
##                unlimit                web
##                      2                  2
```

```
##                 brace               del
##                     2                 2
##              everyth            newlin
##                     2                 2
##               silent                “r
##                     2                 2
##              conduct            reload
##                     2                 2
##             rhistori                rm
##                     2                 2
##             fraction             middl
##                     2                 2
##              obvious          reciproc
##                     2                 2
##               strict           unchang
##                     2                 2
##              concern               cos
##                     2                 2
##              flexibl           minimum
##                     2                 2
##                 pmax              pmin
##                     2                 2
##                  sin               tan
##                     2                 2
##           available”               inf
##                     2                 2
##                isnax       overwritten
##                     2                 2
##               replic              repx
##                     2                 2
##               reserv            situat
##                     2                 2
##                socal                “”
##                     2                 2
##                denot             emerg
##                     2                 2
##                 iter               lab
##                     2                 2
##              nonmiss                ss
##                     2                 2
##               substr             admit
##                     2                 2
##              compact               lie
##                     2                 2
##                lunch             sixth
##                     2                 2
##     attributesobject             cater
##                     2                 2
##              consult      lengthobject
##                     2                 2
##             properti               raw
##                     2                 2
```

```
##                                      represent                                   unambigu
##                                              2                                          2
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##                                              2                                          2
##                                       unclass                                     winter
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##                                              2                                          2
##                                          learn                                   alphabet
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##                                       discret                                      south
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##                                    tapplyincom                                    incster
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##                                              2                                          2
##                                       stderror                                   subclass
##                                              2                                          2
##                                        fortran                                   multipli
##                                              2                                          2
##                                         nonneg                               onedimension
##                                              2                                          2
##                                       referenc                                     cbindn
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##                                          incid                                    trivial
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##                                        encount                                      fewer
##                                              2                                          2
##                                     tableblock                                     aperma
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##                                              2                                          2
##                                         outerx                                       perm
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##                                        surpris                                         bb
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##                                         cbindx                                 crossprodx
##                                              2                                          2
##                                          eigen                                    potenti
##                                              2                                          2
##                                        quadrat                                     rbindx
##                                              2                                          2
##                                           root                                      solut
##                                              2                                          2
##                                        solvea                                    solveab
##                                              2                                          2
##                                             tx                                     absdet
##                                              2                                          2
##                                           alli                                        det
##                                              2                                          2
##                                             ev                                  orthonorm
##                                              2                                          2
```

```
##            prodsvdmd                   sm
##                    2                    2
##                 svdm             asvector
##                    2                    2
##           complement               cyclic
##                    2                    2
##               discov                  res
##                    2                    2
##                ultim                  vec
##                    2                    2
##                cross                  cut
##                    2                    2
##                besid              sublist
##                    2                    2
##           asdatafram              conform
##                    2                    2
##                anyth              comfort
##                    2                    2
##                 mask                safer
##                    2                    2
##                   vw                   \b
##                    2                    2
##                  abl                floor
##                    2                    2
##                 held            housepric
##                    2                    2
##                 perl             presumpt
##                    2                    2
##                price  readtablehousesdata
##                    2                    2
##                 room               around
##                    2                    2
##            headertru                 ncol
##                    2                    2
##               remain         scaninputdat
##                    2                    2
##             editxold       packagedataset
##                    2                    2
##                 beta               cauchi
##                    2                    2
##                  cdf           comprehens
##                    2                    2
##                 logp            multinomi
##                    2                    2
##                 pxxx                 qxxx
##                    2                    2
##                 rate             student’
##                    2                    2
##                upper               weibul
##                    2                    2
##                  ‘r’            bandwidth
##                    2                    2
```

```
##                             bin                           decim
##                               2                               2
##                            eleg                         fivenum
##                               2                               2
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##                               2                               2
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##                             far                             let
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##                 quantilequantil                       righthand
##                               2                               2
##                         qqnormx                            rice
##                               2                               2
##                          twosid                           ratio
##                               2                               2
##                          ttesta                            cdfs
##                               2                               2
##                         kstesta                           maxim
##                               2                               2
##                          qqplot                     wilcoxtesta
##                               2                               2
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##                               2                               2
##                          larger                             yci
##                               2                               2
##                         clearer                            skip
##                               2                               2
##                            view                          bslash
##                               2                               2
##                            emul                         lengthi
##                               2                               2
##                           meani                      ordinarili
##                               2                               2
##                             tst                           tstat
##                               2                               2
##                              xy                              x–
##                               2                               2
##                        altogeth                      furthermor
##                               2                               2
##                          involv                           minor
##                               2                               2
##                          parpch                           adapt
##                               2                               2
##                       algorithm                           canon
##                               2                               2
##                       functionf                           heavi
##                               2                               2
##                         illustr                        nodimnam
##                               2                               2
##                           puzzl                          routin
##                               2                               2
```

```
##              svd            funf
##                2               2
##             bank       catamount
##                2               2
##            don’t  functionamount
##                2               2
##         ifamount           mimic
##                2               2
##      rosswithdraw       toplevel
##                2               2
##         withdraw     graphicsoff
##                2               2
##           hidden         rossbal
##                2               2
##       rprofilesit      rprofileus
##                2               2
##       objectcoef         variant
##                2               2
##           zisnaz              ei
##                2               2
##            polyx         suffici
##                2               2
##               yi               ~
##                2               2
##           period             yax
##                2               2
##        contrpoli        introduc
##                2               2
## optionscontrast           paper
##                2               2
##         textbook           brief
##                2               2
##           concis       criterion
##                2               2
##          devianc        submodel
##                2               2
##             vcov         blocks”
##                2               2
##     datadatafram    multistratum
##                2               2
##       newformula             npk
##                2               2
##    strataformula         “within
##                2               2
##          assumpt          explor
##                2               2
##        mccullagh          nelder
##                2               2
##            prior       regressor
##                2               2
##          subject            wide
##                2               2
```

```
##                            η                           cloglog
##                            2                                 2
##                      inhabit                            island
##                            2                                 2
##                           mu                            silvey
##                            2                                 2
##                       analyz                                ez
##                            2                                 2
##                       failur                           glmymat
##                            2                                 2
##                          ldl                         twocolumn
##                            2                                 2
##                         year                              bate
##                            2                                 2
##                      converg                            critic
##                            2                                 2
##                         curv                                fn
##                            2                                 2
##                    functionp                             guess
##                            2                                 2
##                          nlm                            nlminb
##                            2                                 2
##                      qualiti                               sse
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##                         watt                       dataframexx
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##                      hessian                 linessplinexfit
##                            2                                 2
##                        nlmfn                          outestim
##                            2                                 2
##                   outminimum                                 ±
##                            2                                 2
##                          ace                               ava
##                            2                                 2
##                        bruto                           insight
##                            2                                 2
##                          lme                               lqs
##                            2                                 2
##                         mass                       nonparametr
##                            2                                 2
##                         pick                            reduct
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##                       resist                               rlm
##                            2                                 2
##                       robust                              know
##                            2                                 2
##                        plotf                          versatil
##                            2                                 2
##                      coplota                          straight
##                            2                                 2
##                     axesfals                             count
##                            2                                 2
```

```
##            persp      suppress
##                2             2
##            typel          xaxi
##                2             2
##           across      clockwis
##                2             2
##            mtext         rotat
##                2             2
##              adj        disabl
##                2             2
##        identifyx        justif
##                2             2
##           nearbi        parcol
##                2             2
##             bold        center
##                2             2
##              col        expans
##                2             2
##            greek          ital
##                2             2
##          justifi        palett
##                2             2
##            plain           edg
##                2             2
##             mgpc      surround
##                2             2
##             mfgc           oma
##                2             2
##            share        devoff
##                2             2
##       onefilefals       devlist
##                2             2
##          devnext       devprev
##                2             2
##           whichk         clash
##                2             2
##          davison       hinkley
##                2             2
##          protect        writer
##                2             2
##      doublecolon    getanywher
##                2             2
##          analogu    casesensit
##                2             2
##        compliant      filetest
##                2             2
##           foopng         lower
##                2             2
##         platform        servic
##                2             2
##    crossplatform        header
##                2             2
```

```
##                         normalizepath                            pathexpand
##                                     2                                     2
##                                recogn                                slower
##                                     2                                     2
##                                   url                                    xz
##                                     2                                     2
##                                   zip                                 ablin
##                                     2                                     2
##                          ablinecoeffm                             datadummi
##                                     2                                     2
##                                   lrf                                 rnorm
##                                     2                                     2
##                                   len                            mainresidu
##                                     2                                     2
##                             michelson                                    pi
##                                     2                                     2
##                                  rmfm                                 seqpi
##                                     2                                     2
##                                ‘runs’                                linesz
##                                     2                                     2
##                                nlevel                                 plotw
##                                     2                                     2
##                                 xlimc                                 ylabi
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##                                     2                                     2
##                                 nosit                              osspecif
##                                     2                                     2
##                                 resid                               sitewid
##                                     2                                     2
##                                tmpdir                           ‘namevalue’
##                                     2                                     2
##                            “directly”                           noninteract
##                                     2                                     2
##                             norconsol                               rconsol
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##                               reencod                                 rhome
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##                                  cell                                  flag
##                                     2                                     2
##                                noecho                             noreadlin
##                                     2                                     2
##                                stdout                               trigger
##                                     2                                     2
##                                verbos                                  ‘tk’
##                                     2                                     2
##                                   ‘x’                                rdconv
##                                     2                                     2
##                                 rdtxt                                 shlib
##                                     2                                     2
##                                stderr                                texifi
##                                     2                                     2
```

```
##                vignett           consolebas
##                      2                    2
##             directory’                 fail
##                      2                    2
##                latexex                  mdi
##                      2                    2
##                  mydoc               parent
##                      2                    2
##                    sdi                   sh
##                      2                    2
##               texinput                ‘home
##                      2                    2
##             background                  eof
##                      2                    2
##              usrbinenv                   cn
##                      2                    2
##                 motion            resubmiss
##                      2                    2
##                     vi                   cb
##                      2                    2
##                 “save”               approv
##                      2                    1
##              gentleman                ihaka
##                      1                    1
##                    ion             maechler
##                      1                    1
##                     ii                  iii
##                      1                    1
##                address              adelaid
##                      1                    1
##                 digest                email
##                      1                    1
##                 expand             feedback
##                      1                    1
##                instant                novic
##                      1                    1
##                  pleas              reflect
##                      1                    1
##     rhelprprojectorg                thank
##                      1                    1
##                   warm               accret
##                      1                    1
##                   bell             coauthor
##                      1                    1
##                ephemer               evolut
##                      1                    1
##                  fulli           laboratori
##                      1                    1
##                 latest                 mind
##                      1                    1
##                 modern                newli
##                      1                    1
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##                  peopl                  plan
##                      1                     1
##                 prepar                 rapid
##                      1                     1
##                   rick                    r”
##                      1                     1
##                 ssplus                vehicl
##                      1                     1
##          “environment”         “recommended”
##                      1                     1
##                   bulk               copious
##                      1                     1
##                 dialog            difficulti
##                      1                     1
##              discrimin                 field
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##                      1                     1
##             philosophi               respond
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##                   said                   sas
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##                   spss               tedious
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##             exampletop                  feel
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##                  great              helpsolv
##                      1                     1
##               htmlbase             hyperlink
##                      1                     1
##              keywords’               portabl
##                      1                     1
##                  quick               string”
##                      1                     1
##                 syntax                -za-z-
##                      1                     1
##                ‘search                    ’s
##                      1                     1
##               “charact               amongst
##                      1                     1
##              commandsr              compound
##                      1                     1
##                 emacs”                excess
##                      1                     1
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##                hashmark            indent
##                       1                 1
##                reexecut            scroll
##                       1                 1
##               semicolon        sinkrecord
##                       1                 1
##        sourcecommandsr             decid
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##                     foo               ink
##                       1                 1
##                    junk           meaning
##                       1                 1
##                opportun             “dot”
##                       1                 1
##                 assignx          lastvalu
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##               sidebysid          ‘points’
##                       1                 1
##                   “less           “minus”
##                       1                 1
##                  byvalu             cminx
##                       1                 1
##                fromvalu           irrelev
##                       1                 1
##              lengthvalu              maxx
##                       1                 1
##                   meanx              nbyp
##                       1                 1
##                    pbyp          prioriti
##                       1                 1
##                   prodx           pvariat
##                       1                 1
##                    rais           seqfrom
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##               seqlength             seqto
##                       1                 1
##                sortlist             sortx
##                       1                 1
##                   sqrti              sumx
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##             sumxlengthx  sumxmeanxlengthx
##                       1                 1
##                  tovalu              varx
##                       1                 1
##               “numbers”       alongvector
##                       1                 1
##                     cna       counterpart
##                       1                 1
##                endtoend             fifth
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##                   inequ         intersect
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##              isnaz      lengthvector
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##       backspace—se             blank
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##         collapsess            cstyle
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##            delimit        differenti
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##            isnanxx            isnaxx
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##                tab             xvalu
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##               appl            banana
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##   fruitcappleorang         matrices’
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##     multidimension        namesfruit
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##             rememb         subvector
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##  vectorindexvector             ‘data
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##           project’           amalgam
##                  1                 1
##              appar      ascharacterz
##                  1                 1
##     asintegerdigit         assometh
##                  1                 1
##               atom       attributes”
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```

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##         constitu          explain
##                1                1
##        fundament         indirect
##                1                1
##           invest          lengthz
##                1                1
##       modeobject            modez
##                1                1
##          possess      reconstruct
##                1                1
##           revers         roundoff
##                1                1
##         “atomic”         “intrins
##                1                1
##       “property”      “recursive”
##                1                1
##          “value”       attrobject
##                1                1
##            attrz         circumst
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##         creation             date
##                1                1
##      lengthalpha       nonintrins
##                1                1
##        objectori            react
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##           report          truncat
##                1                1
##         ‘formal’          “empty”
##                1                1
##      unclasswint         asfactor
##                1                1
##       australian            capit
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##             ctas            eight
##                1                1
##         factorst          incmean
##                1                1
##     levelsstatef           mnemon
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##            money         northern
##                1                1
##       queensland           state’
##                1                1
##         tasmania         victoria
##                1                1
##             wale          western
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##     ‘tapplyincom           “real”
##                1                1
##         “sorted”         categori
##                1                1
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##         instanc        investig
##               1               1
##           liner              qt
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##             sex  sqrtvarxlengthx
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##      tdistribut            alon
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##         fastest      kdimension
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##         “column          arrayc
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##            xviv  arraydatavector
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##     elementbyel        mismatch
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##       noncommut          outera
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##           permj          plotfr
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##     singledigit              ta
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##     tableouterd      transposit
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##           twice     xlabdetermin
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```

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##          ylabfrequ          “obvious”
##                  1                  1
##             “sees”           accuraci
##                  1                  1
##              adopt            algebra
##                  1                  1
##             ambigu           choleski
##                  1                  1
##              diagk              diagm
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##              diagv               loss
##                  1                  1
##              ncola              nrowa
##                  1                  1
##            nvector             promot
##                  1                  1
##             scalar            solveax
##                  1                  1
##            unstabl            whichev
##                  1                  1
##    “crossproducts”            absdetm
##                  1                  1
##        eigensmvalu              evval
##                  1                  1
##              evvec           followup
##                  1                  1
##          functionm              grand
##                  1                  1
##               hint             lsdiag
##                  1                  1
##             lsfitx            modulus
##                  1                  1
##           onlyvalu            symmetr
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##                 tr              trace
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##           truevalu                 tv
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##              xplus          asvectorx
##                  1                  1
##           cbindarg          columnwis
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##             matter             offici
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##              older        qrcoefxplus
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##       qrfittedxplus       qrresidxplus
##                  1                  1
##             redund              rough
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##             rowwis         sideeffect
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```

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##                ‘backslash’                     class”
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##             factorcutincom                  higherway
##                          1                          1
##                       kway         tableincomefstatef
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##                tablestatef                tapplystatef
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##                 nochildren                   transfer
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##             accountantshom                     clista
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##        dataframehomestatef                     freeli
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##                    listabc                      listb
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##                      listc               listmatrixmat
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##             listnameobject                  lootincom
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##               namemobjectm                    satisfi
##                          1                          1
##                    scratch                shotincomef
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##                    somehow            attachanyoldlist
##                          1                          1
##               attachlentil                     gather
##                          1                          1
##                    greater                     leftov
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##                   lentilsv                   lentilsw
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##                             resort                    unwant
##                                  1                         1
##                         ‘database’                   confirm
##                                  1                         1
##                              track                       awk
##                                  1                         1
##                               fair                       imp
##                                  1                         1
##                           nonnumer                 ortexport
##                                  1                         1
##                             primit                       sed
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##                           byrowtru                datainfert
##                                  1                         1
##                             elabor                 establish
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##                             listid       matrixscanlightdat
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##                            obsolet                  reassign
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##                    datapackagerpart              datapuromycin
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##                       editdatafram                   fixxold
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##                               rich               spreadsheet
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##                     spreadsheetlik                     accur
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##                              andom                     binom
##                                  1                         1
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##                          dmultinom                 exponenti
##                                  1                         1
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## httpscranrprojectorgpackagesuppdist                     hyper
##                                  1                         1
##                       hypergeometr                    lambda
##                                  1                         1
##                              lnorm                   lognorm
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##                            meanlog                    nbinom
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```

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##            noncentr                norm
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##              notabl                 poi
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##              prefix                  pt
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##              ptukey               pxxxt
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##                  qf              qtukey
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##          randomnumb              rhyper
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##           rmultinom                 rng
##                   1                   1
##           rsignrank             rwilcox
##                   1                   1
##                rxxx               sdlog
##                   1                   1
##            signrank             student
##                   1                   1
##            suppdist                unif
##                   1                   1
##              wilcox                 ‘d’
##                   1                   1
##                 ‘p’                 ‘q’
##                   1                   1
##        “integrated”         attachfaith
##                   1                   1
##               autom         fivenumerupt
##                   1                   1
##               leaf”  linesdensityerupt
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##              median             probtru
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##            rugerupt                  sj
##                   1                   1
##                  st          stemandleaf
##                   1                   1
##           stemerupt        summaryerupt
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##       trialanderror             univari
##                   1                   1
##       “interesting”               “stem
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##                 fnx         meanmeanlong
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##               minut              overlay
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##       plotecdferupt         plotecdflong
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##                          pnormx                       qqlinelong
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##                      qqnormlong                    sdsqrtvarlong
##                               1                                1
##                       agreement                            calgm
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##                             dsn                           fusion
##                               1                                1
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##                      kstestlong                           latent
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##                           pnorm                   qqplotqtppoint
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##                             q-q                               rt
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##                 shapirotestlong                      sqrtvarlong
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##                               1                                1
##                            xlab                      “classical”
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##                       plotecdfa                        plotecdfb
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##                       subexpress                       wherev
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##                               xc                       xyplot
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##                               yc               “shortcircuit”
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##                       discontinu                       faster
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##                          object’                       ‘whole
##                                1                            1
##                           “next”                          bit
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##                       bslashxmat                    datafemal
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##                         nameexpr                           ns
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##                          qrcoefx                     regcoeff
##                                1                            1
##                             safe                       steps”
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##                     “nameobject”                asfactorblock
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##                   asfactorvarieti                  assignment”
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##                asvectortableblock        asvectortablevarieti
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##                            bdeff                functionblock
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##                           govern            lengthlevelsblock
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##                     lengthlevelsvarieti                               liter
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##                               functiona                             inherit
##                                       1                                   1
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##                                    naiv                               ncolx
##                                       1                                   1
##                             nodimnamesx                               nrowx
##                                       1                                   1
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##                                 pattern                              qualit
##                                       1                                   1
##                                    repb                            repsqrtr
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##                               trapezium                        varietycvsvv
##                                       1                                   1
##                                   “wrap                           ascertain
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##                               functionn                              ifabsa
##                                       1                                   1
##                                     nsq                              printi
##                                       1                                   1
##                                  printx                              printz
##                                       1                                   1
##                                  resolv                             returna
##                                       1                                   1
##                              returnfunf                              static
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##                    therefor                     ‘area’
##                           1                          1
##                       ‘fun’                    catyour
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##                      robert                       ross
##                           1                          1
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##                   withdrawn         catpastedatenadiosn
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##                   continuet                       lack
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##                 librarymass                   mystuffr
##                           1                          1
##                optionsdigit               optionsprompt
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##                    printout                  robertbal
##                           1                          1
##                 rossdeposit  sourcefilepathsysgetenvhom
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##                        task                   asmatrix
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##                    asterisk                    coefaov
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##                           1                          1
##                  coeflistof                     coefnl
##                           1                          1
##               coefsummarynl                    fashion
##                           1                          1
##          getanywherecoefaov              getsmethodcoef
##                           1                          1
##        methodsclassdatafram                methodscoef
##                           1                          1
##                 methodsplot               namespacestat
##                           1                          1
##                        none                     nonvis
##                           1                          1
##                     presenc                   question
##                           1                          1
##                      regist                        six
##                           1                          1
##                   usemethod               usemethodcoef
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##                       gen                     gencl
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##                 extractor                homoscedast
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##                    newcom                 parameter
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##                    scheme              statistician
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##                     stori                    tensor
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##            “interactions”              “subclasses”
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##                 alia           anovaobject
##                    1                     1
##   coefficientsobject            coefobject
##                    1                     1
##       devianceobject         formulaobject
##                    1                     1
##            hierarchi                 kappa
##                    1                     1
##            lmformula      newdatadatafram
##                    1                     1
##           plotobject         predictobject
##                    1                     1
##          printobject                  proj
##                    1                     1
##           regardless           residobject
##                    1                     1
##      residualsobject            stepobject
##                    1                     1
##              stepwis             streamlin
##                    1                     1
##     anovafittedmodel            aovformula
##                    1                     1
##             aovyield            comprehend
##                    1                     1
##         datafarmdata               decreas
##                    1                     1
##      errorfarmsblock   errorstrataformula
##                    1                     1
##                 farm                farms”
##                    1                     1
##             formula”              hierarch
##                    1                     1
##       inconsequenti            interblock
##                    1                     1
##          meanformula              newmodel
##                    1                     1
##             recoveri                   smf
##                    1                     1
##       summaryobject        updateoldmodel
##                    1                     1
##       variancecovari            vcovobject
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##                 glmformula                 instrument
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##           inversegaussian                      name”
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##                    “famili                       aris
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##                       cldp                 dataframex
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##                        fml                       fmod
##                          1                          1
##                        fmp                  functionb
##                          1                          1
##                     genuin                      grace
##                          1                          1
##                  kalythosi                  kalythosn
##                          1                          1
##               kalythosymat                  ldcoeffml
##                          1                          1
##                  ldcoeffmp                        ldp
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##                  loglinear                nongaussian
##                          1                          1
##                     overal            poissonlinksqrt
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##                 squareroot                 summaryfml
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##                             summaryfmp                           surrog
##                                      1                                1
##                                  trial                        wormcount
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##                                     ϕz                        ‘success’
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##                                     −β                         approach
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##                                 arisen                          biochem
##                                      1                                1
##                          characterist                         guarante
##                                      1                                1
##                               incident                        lackoffit
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##                                      1                                1
##                        michaelismenten                             nlsi
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##                                      1                                1
##                        solveouthessian       sqrtdiagoutminimumlengthi
##                                      1                                1
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##                             summaryfit                       sumofsquar
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##                                acepack                           bifurc
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##                                conclud                              ded
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##                                 ension                              ext
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##                                    gam                        heterogen
##                                      1                                1
##                           highlyresist                          homogen
##                                      1                                1
##                              httpscran                httpscranrproject
##                                      1                                1
##  httpscranrprojectorgpackageacepack     httpscranrprojectorgpackagegam
##                                      1                                1
##     httpscranrprojectorgpackagemass    httpscranrprojectorgpackagemda
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```

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##      httpscranrprojectorgpackagenlm                      logchoosen
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##                           springer                            wiley
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##                              “blue                           “green
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##                             “white
##                                  1
```

```
new_freq<-freq[freq>50]
new_freq
```

```
##  function       use         r    vector         x       can      data      plot
##       420       397       363       254       239       200       194       175
##     model         y      valu      file    exampl      list   graphic      name
##       165       164       155       146       144       135       134       134
##  argument      will    object   command     array       may   variabl    matrix
##       126       120       116       114       112       109       103       101
##    packag         b         c   charact    number       see      line       one
##        93        90        86        86        82        82        81        80
##      form       way    factor      also   paramet   chapter       fit       set
##        80        80        79        78        77        77        76        75
##     frame       two     devic distribut     first      oper      case   express
##        74        73        68        67        66        65        64        64
##     point    result     given    compon    window   default     avail         •
##        63        62        62        61        60        60        59        58
##    assign      mean         m     defin   specifi     index    column   statist
##        56        56        55        55        55        54        54        53
##    differ      give      page   current      make    length directori      call
##        53        52        52        52        51        51        51        51
```

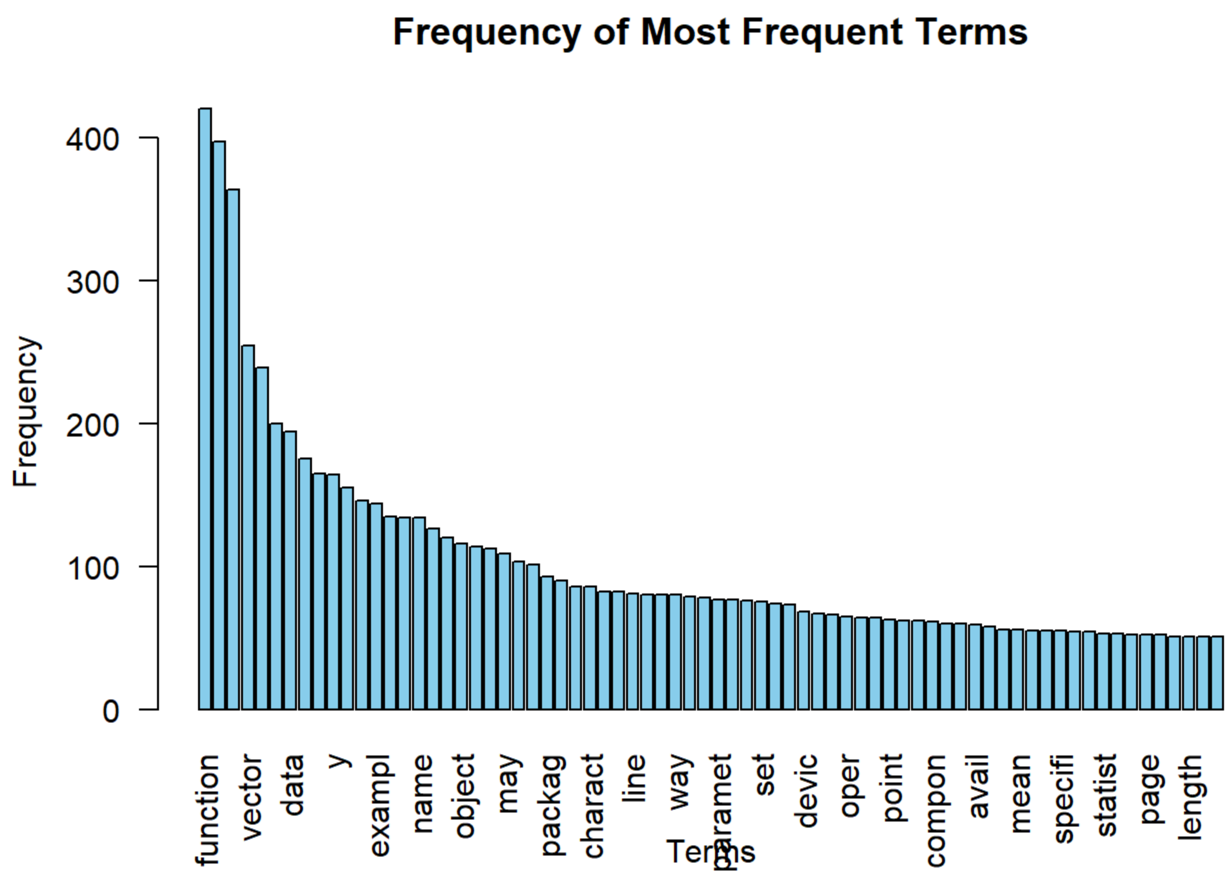
```
# Extract words (terms) and their frequencies
words <- names(new_freq)
words
```

```
##  [1] "function"  "use"       "r"         "vector"    "x"         "can"
##  [7] "data"      "plot"      "model"     "y"         "valu"      "file"
## [13] "exampl"    "list"      "graphic"   "name"      "argument"  "will"
## [19] "object"    "command"   "array"     "may"       "variabl"   "matrix"
## [25] "packag"    "b"         "c"         "charact"   "number"    "see"
## [31] "line"      "one"       "form"      "way"       "factor"    "also"
## [37] "paramet"   "chapter"   "fit"       "set"       "frame"     "two"
## [43] "devic"     "distribut" "first"     "oper"      "case"      "express"
## [49] "point"     "result"    "given"     "compon"    "window"    "default"
## [55] "avail"     "•"         "assign"    "mean"      "m"         "defin"
## [61] "specifi"   "index"     "column"    "statist"   "differ"    "give"
## [67] "page"      "current"   "make"      "length"    "directori" "call"
```

```
max(freq)
```

```
## [1] 420
```

```
# Create barplot #Better
barplot(new_freq,
        main = "Frequency of Most Frequent Terms",
        xlab = "Terms",
        ylab = "Frequency",
        names.arg = words,  # Display words on x-axis
        las = 2,  # Rotate x-axis labels if needed
        col = "skyblue")  # Specify color if desired
```



8

```r
library(car)
```

```
## Warning: package 'car' was built under R version 4.3.3
```

```
## Loading required package: carData
```

```
## Warning: package 'carData' was built under R version 4.3.3
```

```r
data(airquality)

# a) shapiro-Wilk test of Normality Test
aq <- airquality
str(aq)
```

```
## 'data.frame':    153 obs. of  6 variables:
##  $ Ozone  : int  41 36 12 18 NA 28 23 19 8 NA ...
##  $ Solar.R: int  190 118 149 313 NA NA 299 99 19 194 ...
##  $ Wind   : num  7.4 8 12.6 11.5 14.3 14.9 8.6 13.8 20.1 8.6 ...
##  $ Temp   : int  67 72 74 62 56 66 65 59 61 69 ...
##  $ Month  : int  5 5 5 5 5 5 5 5 5 5 ...
##  $ Day    : int  1 2 3 4 5 6 7 8 9 10 ...
```

```
#Here the number of observations is greater than 100, so we do ks test for
#normality
shapiro_test_result<-shapiro.test(aq$Wind)
shapiro_test_result
```

```
##
##  Shapiro-Wilk normality test
##
## data:  aq$Wind
## W = 0.98575, p-value = 0.1178
```

```
# Here, p value is greater than 0.05 so, it follows normal distribution.

# b) Variance Test
# for equality of variance
# Perform a Bartlett test to compare variances of wind data by month
bartlett.test(Wind ~ Month, data = aq)
```

```
##
##  Bartlett test of homogeneity of variances
##
## data:  Wind by Month
## Bartlett's K-squared = 1.6178, df = 4, p-value = 0.8056
```

```
#Here, p value is greater than 0.05, thus the variance of wind with respect to
#months are equal

#c
#Fitting one way anova
anova_test<- oneway.test(aq$Wind~factor(aq$Month), var.equal = TRUE)
anova_test
```

```
##
##  One-way analysis of means
##
## data:  aq$Wind and factor(aq$Month)
## F = 3.529, num df = 4, denom df = 148, p-value = 0.00879
```

```
(anova_model <- aov(Wind ~ as.factor(Month), data = aq))
```

```
## Call:
##    aov(formula = Wind ~ as.factor(Month), data = aq)
##
## Terms:
##                 as.factor(Month) Residuals
## Sum of Squares          164.2708 1722.2831
## Deg. of Freedom                4       148
##
## Residual standard error: 3.411312
## Estimated effects may be unbalanced
```

```
#Interpretation: Here, the p value is less than 0.05, thus the mean wind speed
#in various months are different is not equal.



#d
# Apply TukeyHSD to the ANOVA model
tukey_result <- TukeyHSD(anova_model)
print(tukey_result)
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Wind ~ as.factor(Month), data = aq)
##
## $`as.factor(Month)`
##            diff       lwr        upr     p adj
## 6-5 -1.35591398 -3.768713  1.0568846 0.5305524
## 7-5 -2.68064516 -5.073585 -0.2877054 0.0197174
## 8-5 -2.82903226 -5.221972 -0.4360925 0.0117066
## 9-5 -1.44258065 -3.855379  0.9702179 0.4674045
## 7-6 -1.32473118 -3.737530  1.0880674 0.5535894
## 8-6 -1.47311828 -3.885917  0.9396803 0.4456532
## 9-6 -0.08666667 -2.519162  2.3458285 0.9999786
## 8-7 -0.14838710 -2.541327  2.2445527 0.9998052
## 9-7  1.23806452 -1.174734  3.6508631 0.6176733
## 9-8  1.38645161 -1.026347  3.7992502 0.5081147
```

```
# Interpretation: The pairs in  which p value is less than 0.05 ie. 7-5 month and
# 8-5 month has difference in mean wind. All other pairs have similar mean
#wind values.
```

9

```
data<-USArrests
head(data)
```

```
##            Murder Assault UrbanPop Rape
## Alabama      13.2     236       58 21.2
## Alaska       10.0     263       48 44.5
## Arizona       8.1     294       80 31.0
## Arkansas      8.8     190       50 19.5
## California    9.0     276       91 40.6
## Colorado      7.9     204       78 38.7
```

```
str(data)
```

```
## 'data.frame':    50 obs. of  4 variables:
##  $ Murder  : num  13.2 10 8.1 8.8 9 7.9 3.3 5.9 15.4 17.4 ...
##  $ Assault : int  236 263 294 190 276 204 110 238 335 211 ...
##  $ UrbanPop: int  58 48 80 50 91 78 77 72 80 60 ...
##  $ Rape    : num  21.2 44.5 31 19.5 40.6 38.7 11.1 15.8 31.9 25.8 ...
```

```
# a Split 70 30
set.seed(13)
ind <- sample(2, nrow(data),

              replace=T, prob = c(0.7, 0.3))

train <- data[ind==1,]

test <- data[ind==2,]

# b) fit linear and KNN
# Load necessary libraries
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.3.3
```

```
##
## Attaching package: 'ggplot2'
```

```
## The following object is masked from 'package:NLP':
##
##     annotate
```

```
# For plotting
library(caret)
```

```
## Warning: package 'caret' was built under R version 4.3.3
```

```
## Loading required package: lattice
```

```
## Warning: package 'lattice' was built under R version 4.3.3
```

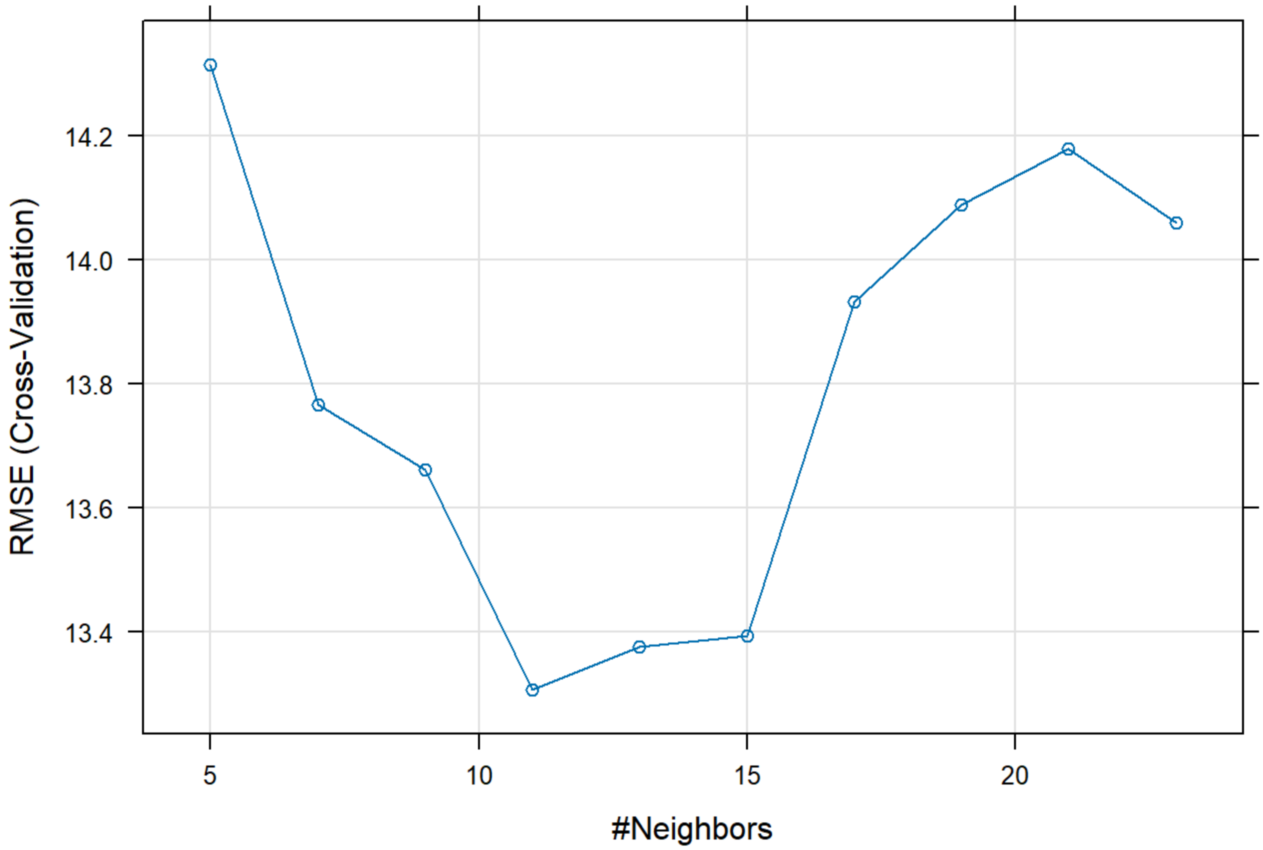
```r
linear_model <- lm(UrbanPop ~ Murder + Assault + Rape, data=data)
#  Fit the linear regression  using lm function.

summary(linear_model)
```

```
##
## Call:
## lm(formula = UrbanPop ~ Murder + Assault + Rape, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -35.456  -6.950   0.077   7.770  25.221
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 52.84187    4.82483  10.952 2.09e-14 ***
## Murder      -1.41154    0.71954  -1.962   0.0559 .
## Assault      0.05190    0.04161   1.247   0.2186
## Rape         0.69841    0.26776   2.608   0.0122 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.08 on 46 degrees of freedom
## Multiple R-squared:  0.2337, Adjusted R-squared:  0.1837
## F-statistic: 4.676 on 3 and 46 DF,  p-value: 0.006208
```

```r
# Check the model summary
# Load necessary libraries
library(caret)

# Standardize the data
preProc <- preProcess(data[, -3], method=c("center", "scale"))
data_std <- predict(preProc, data[, -3])

# Add the dependent variable back
data_std$UrbanPop <- data$UrbanPop

# Define the control method for training
train_control <- trainControl(method="cv", number=10)

# Train the KNN model
knn_model <- train(UrbanPop ~ Murder + Assault + Rape, data=data_std, method="knn", trControl=tr
ain_control, tuneLength=10)

# Check the results
print(knn_model)
```

```
## k-Nearest Neighbors
##
## 50 samples
##  3 predictor
##
## No pre-processing
## Resampling: Cross-Validated (10 fold)
## Summary of sample sizes: 44, 45, 45, 46, 45, 46, ...
## Resampling results across tuning parameters:
##
##   k   RMSE      Rsquared   MAE
##    5  14.31598  0.2751990  12.40538
##    7  13.76603  0.3280303  11.35714
##    9  13.66134  0.3037106  11.31421
##   11  13.30576  0.3831001  10.91229
##   13  13.37505  0.3749772  10.93414
##   15  13.39414  0.4383720  11.02686
##   17  13.93350  0.3323776  11.60188
##   19  14.08870  0.1857393  11.74160
##   21  14.18037  0.2819866  11.98591
##   23  14.05966  0.2752558  11.83362
##
## RMSE was used to select the optimal model using the smallest value.
## The final value used for the model was k = 11.
```

```
plot(knn_model)
```




```
# c) predict in test data
linear_predictions <- predict(linear_model, test)
linear_predictions
```

```
##        Alabama     California       Delaware        Florida          Idaho
##       61.26440       82.81805       67.90100       70.77016       65.31736
##       Illinois          Maine North Carolina   North Dakota   Rhode Island
##       67.84696       59.63298       63.22675       59.14656       62.87013
##          Texas       Virginia      Wisconsin
##       63.15682       63.39738       59.46543
```

```
knn_predictions <- predict(knn_model, test)
knn_predictions
```

```
##  [1] 66.18182 70.00000 66.18182 67.83333 70.00000 67.83333 70.00000 66.18182
##  [9] 70.00000 66.18182 67.83333 70.00000 70.00000
```

```r
#d) comparing the model
linear_mse <- mean((test$UrbanPop - linear_predictions)^2)
linear_rmse <- sqrt(linear_mse)
linear_r2 <- 1 - (sum((test$UrbanPop - linear_predictions)^2) / sum((test$UrbanPop - mean(test$U
rbanPop))^2))
linear_mse
```

```
## [1] 160.1733
```

```r
linear_rmse
```

```
## [1] 12.65596
```

```r
linear_r2
```

```
## [1] 0.3348089
```

```r
knn_mse <- mean((test$UrbanPop - knn_predictions)^2)
knn_rmse <- sqrt(knn_mse)
knn_r2 <- 1 - (sum((test$UrbanPop - knn_predictions)^2) / sum((test$UrbanPop - mean(test$UrbanPo
p))^2))

knn_mse
```

```
## [1] 254.4571
```

```r
knn_rmse
```

```
## [1] 15.95171
```

```r
knn_r2
```

```
## [1] -0.05674686
```

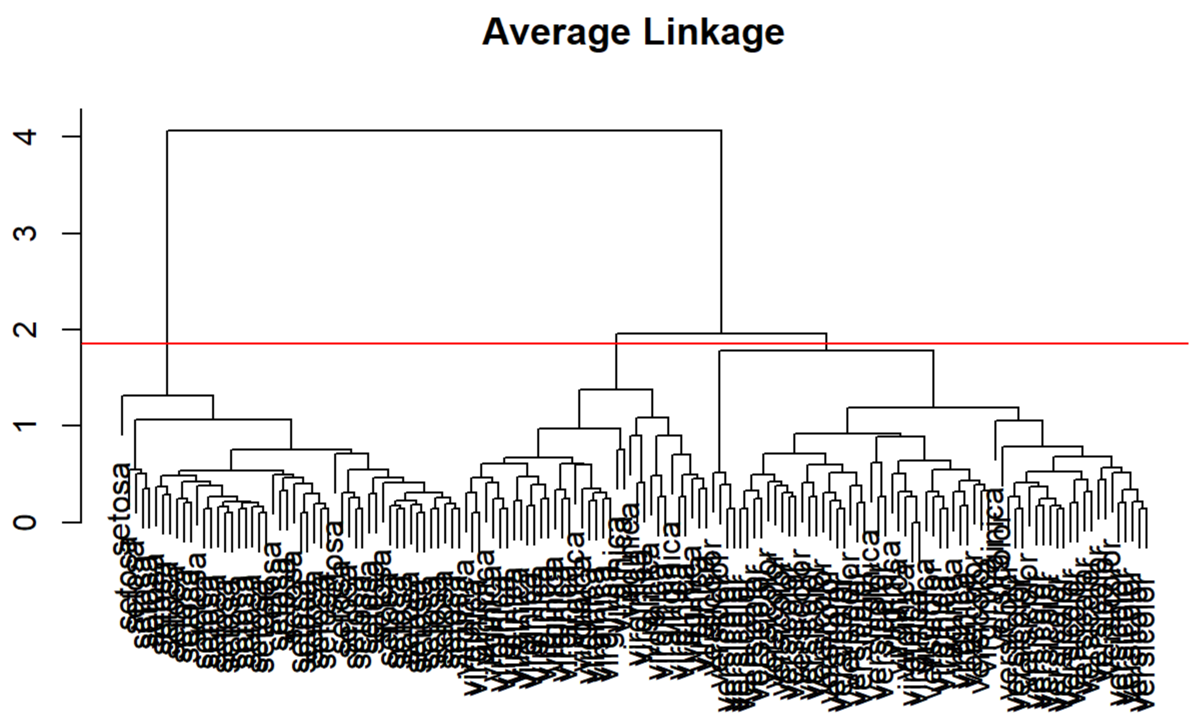
```r
#from the above value we can conclude that the we can choose linear _mse
#linear mse is less so we can choose linear model
#at last linear model is better than knn from this result
```

10

```
ir_label <- iris$Species
ir_data <- iris[,-5]
head(ir_data)
```

```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width
## 1          5.1         3.5          1.4         0.2
## 2          4.9         3.0          1.4         0.2
## 3          4.7         3.2          1.3         0.2
## 4          4.6         3.1          1.5         0.2
## 5          5.0         3.6          1.4         0.2
## 6          5.4         3.9          1.7         0.4
```

```
## A) Hierarchical clustering using average
data.dist <- dist(ir_data)
plot(hclust(data.dist, method = "average"), xlab = "", sub = "", ylab = "",
     labels = ir_label, main = "Average Linkage")

## B) Best value is provided by average linkage
plot(hclust(data.dist, method = "average"), xlab = "", sub = "", ylab = "",
     labels = ir_label, main = "Average Linkage")

abline(h = 1.85, col = "red")
```




```
## C) fit k-mean clustering
kmeans.c3<-kmeans(ir_data,centers = 3,nstart = 20)
kmeans.c3
```

```
## K-means clustering with 3 clusters of sizes 38, 62, 50
##
## Cluster means:
##   Sepal.Length Sepal.Width Petal.Length Petal.Width
## 1     6.850000    3.073684     5.742105    2.071053
## 2     5.901613    2.748387     4.393548    1.433871
## 3     5.006000    3.428000     1.462000    0.246000
##
## Clustering vector:
##   [1] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
##  [38] 3 3 3 3 3 3 3 3 3 3 3 3 3 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
##  [75] 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 1 1 1 1 2 1 1 1 1
## [112] 1 1 2 2 1 1 1 1 2 1 2 1 2 1 1 2 2 1 1 1 1 1 2 1 1 1 1 2 1 1 1 2 1 1 1 2 1
## [149] 1 2
##
## Within cluster sum of squares by cluster:
## [1] 23.87947 39.82097 15.15100
##  (between_SS / total_SS =  88.4 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
#d) compare using confusion matrix
cm<-table(iris$Species,kmeans.c3$cluster)
cm
```

```
##
##               1  2  3
##   setosa      0  0 50
##   versicolor  2 48  0
##   virginica  36 14  0
```

```
(accuracy<-
    sum(diag(cm))/sum(cm))
```

```
## [1] 0.32
```

```
# Accuracy of k-mean clustering is 0.893 while size of cluster is 3. so we can use it.
```