MD004 - Naive Bayes y Analisis de Sentimientos

Cargama de datos

In [61]:
```
library(e1071)
library(caret)
library(tm)
library(SnowballC)
library(wordcloud)
library(gmodels)
library(wordcloud)
library(textclean)
library(textstem)
```

In [2]:
```
data = read.csv(file='sentiment_dataset.csv', header=TRUE)
str(data)
```

```
'data.frame':   891 obs. of  3 variables:
 $ ï..package_name: chr  "com.facebook.katana" "com.facebook.katana" "com.faceboo
k.katana" "com.facebook.katana" ...
 $ review         : chr  " privacy at least put some option appear offline. i mea
n for some people like me it's a big pressure to be seen"| __truncated__ " messen
ger issues ever since the last update, initial received messages don't get pushed
 to the messenger app a"| __truncated__ " profile any time my wife or anybody has
 more than one post and i view them it would take me to there profile s"| __trunca
ted__ " the new features suck for those of us who don't have a working back butto
n can you guys make the videos able t"| __truncated__ ...
 $ polarity       : int  0 0 0 0 0 0 0 0 0 0 ...
```

In [3]:
```
head(data)#de forma predefinida retorna las primeras 6 observations
tail(data)#de forma predefinida retorna las últimas 6 observations
colnames(data)
```

A data.frame: 6 × 3

	ï..package_name	review	polarity
	<chr>	<chr>	<int>
1	com.facebook.katana	privacy at least put some option appear offline. i mean for some people like me it's a big pressure to be seen online like you need to response on every message or else you be called seenzone only. if only i wanna do on facebook is to read on my newsfeed and just wanna response on message i want to. pls reconsidered my review. i tried to turn off chat but still can see me as online.	0
2	com.facebook.katana	messenger issues ever since the last update, initial received messages don't get pushed to the messenger app and you don't get notification in the facebook app or messenger app. you open the facebook app and happen to see you have a message. you have to click the icon and it opens messenger. subsequent messages go through messenger app, unless you close the chat head... then you start over with no notification and having to go through the facebook app.	0
3	com.facebook.katana	profile any time my wife or anybody has more than one post and i view them it would take me to there profile so that i can view them all at once. now when i try to view them it tells me that the page that i requested is not available. i've restarted my phone i even cleard the cache and i've uninstalled and reinstalled the app and it is still doing it. please fix it thank you	0
4	com.facebook.katana	the new features suck for those of us who don't have a working back button can you guys make the videos able to be slid to the left to exit the video. as i have to force close facebook to exit	0
5	com.facebook.katana	forced reload on uploading pic on replying comment last night i tried to reply a comment by uploading a photo from my phone. when i press on the button to select photos the app automatically goes back to the main page. on other occasions, i could enter to my gallery to select my image but as soon as i selected an image and press done, the program, again, forced reload and suddenly go back to the main page. please fix this and i will change my rating. thank you.	0
6	com.facebook.katana	idk i can't edit my posts? things such as my profile picture, when i edit it, it becomes grey and says that it is no longer available. please fix. i have an htc desire. will rate 5 stars shown fixed Ä‘ÂŸÂ˜Â”	0

A data.frame: 6 × 3

	ï..package_name	review	polarity
	<chr>	<chr>	<int>
886	com.rovio.angrybirds	too many ads far more adverts than any other game i've played. i know it's free and they need the ads to make a profit but there needs to be a balance.	1
887	com.rovio.angrybirds	loved it i looooooooooooooovvved it because it is incredible awesome and it's in go power and make a new clash of clans the same thing butt better	1
888	com.rovio.angrybirds	all time legendary game the birthday party levels and short fuse levels are fantastic.especially when the pigs crash onto different chemicals is just great.suggestion to all those players who cringe about too much ads is close ur wi-fi connection and then play the game.then the ads won't trouble you.	1
889	com.rovio.angrybirds	ads are way to heavy listen to the bad reviews. there are ads after every round, whether you pass it or fail it. sometimes there are ads before the next round starts to. you spend more time on ads than game play. i develop web apps, and honestly many people rely on ads to make a living. i can appreciate that all to well. however, these developers have went far beyond that. frankly, they are disrespectful nitwits.	0
890	com.rovio.angrybirds	fun works perfectly well. ads aren't as annoying as you think, especially for a free game.	1
891	com.rovio.angrybirds	they're everywhere i see angry birds everywhere because i can't stop playing this game. get out my head devs! 4 Ä´ÂŸÂŒÂŸ because nothing's perfect	1

'ï..package_name' · 'review' · 'polarity'

In [4]:
```
data$aplicacion <- data$'ï..package_name'
data$'ï..package_name' <- NULL
str(data)
```

```
'data.frame':   891 obs. of  3 variables:
 $ review    : chr  " privacy at least put some option appear offline. i mean for
some people like me it's a big pressure to be seen"| __truncated__ " messenger is
sues ever since the last update, initial received messages don't get pushed to th
e messenger app a"| __truncated__ " profile any time my wife or anybody has more
than one post and i view them it would take me to there profile s"| __truncated__
" the new features suck for those of us who don't have a working back button can
you guys make the videos able t"| __truncated__ ...
 $ polarity  : int  0 0 0 0 0 0 0 0 0 0 ...
 $ aplicacion: chr  "com.facebook.katana" "com.facebook.katana" "com.facebook.kat
ana" "com.facebook.katana" ...
```

Analisis de dominio

Como primer punto a destacar, observamos que nuestra base de datos de texto se encuentra en ingles. Con lo cual, al limpiar las palabras para armar una matriz lo mas pura posible, tendremos que tener en cuenta estructuras de este idioma. Como por

ejemplo: cuales son sus acentos, cuales son sus signos de exclamacion e interrogacion, si tienen letras particulares que no ayuden a la comprension del texto, si utilizan o no utilizan el apostrofe para separar palabras, si se encuentran dobles o triples espacios, si tienen sustantivos o adjetivos separados por genero por una letra, etc.

In [5]:
```
str(data)
```

```
'data.frame':   891 obs. of  3 variables:
 $ review    : chr  " privacy at least put some option appear offline. i mean for some people like me it's a big pressure to be seen"| __truncated__ " messenger is sues ever since the last update, initial received messages don't get pushed to th e messenger app a"| __truncated__ " profile any time my wife or anybody has more than one post and i view them it would take me to there profile s"| __truncated__ " the new features suck for those of us who don't have a working back button can you guys make the videos able t"| __truncated__ ...
 $ polarity  : int  0 0 0 0 0 0 0 0 0 0 ...
 $ aplicacion: chr  "com.facebook.katana" "com.facebook.katana" "com.facebook.katana" "com.facebook.katana" ...
```

Veamos como esta distribuida la carga de cada aplicacion sobre nuestro data set de reviews.

In [6]:
```
# Proporción de clases
round(prop.table(table(data$aplicacion))*100, digits = 1)
```

```
       com.android.chrome        com.dropbox.android 
                      4.4                         4.5 
            com.evernote        com.facebook.katana 
                      4.5                         4.5 
         com.facebook.orca    com.google.android.talk 
                      4.5                         4.4 
         com.hamrokeyboard             com.hamropatro 
                      4.4                         4.3 
     com.imangi.templerun2    com.king.candycrushsaga 
                      4.5                         4.5 
      com.linkedin.android      com.opera.mini.native 
                      4.5                         4.5 
      com.rovio.angrybirds    com.shirantech.kantipur 
                      4.4                         4.0 
                 com.Slack com.supercell.clashofclans 
                      4.5                         4.5 
           com.tencent.mm        com.twitter.android 
                      4.4                         4.4 
        com.uc.browser.en             com.viber.voip 
                      4.5                         4.5 
             com.whatsapp       jabanaki.todo.todoly 
                      4.4                         2.7 
       org.mozilla.firefox 
                      4.5 
```

Observamos como esta distribuida la carga de cada cateogria de nuestra variable polarity.

In [69]:
```
# Proporción de clases
round(prop.table(table(data$polarity))*100, digits = 1)
```

```
  0    1 
65.5 34.5 
```

Observamos que contamos con el 34,5% de los casos en donde registramos comentarios con carga de sentimiento. Para continuar con nuestro analisis fijamos nuestra variable como un factor para poder trabajarla luego.

In [8]:
```
# Establecemos el tipo de dato a factor
data$polarity = factor(data$polarity)
data$polarity
```

0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 ·
0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 ·
0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 ·
0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 ·
1 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 1 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 ·
1 · 1 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 1 · 1 · 1 · 1 · 0 · 1 · 1 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 1 · 1 · 0 · 0 · 1 · 1 · 0 · 0 ·
0 · 0 · 1 · 1 · 0 · 0 · 0 · 0 · … · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 0 · 1 · 1 · 1 · 1 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 ·
0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 1 · 0 · 1 · 0 · 0 ·
0 · 0 · 0 · 0 · 0 · 1 · 1 · 1 · 1 · 0 · 1 · 0 · 1 · 0 · 1 · 1 · 1 · 1 · 1 · 0 · 1 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 ·
0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 1 · 1 ·
1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 ·
1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 0 · 1 · 1 · 0 · 1 · 0 · 0 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 · 1 ·
1 · 1 · 0 · 0 · 1 · 1 · 1 · 0 · 0 · 1 · 1 · 1 · 1 · 1 · 0 · 1 · 1

▶ **Levels**:

Mezclamos la base de datos para darle un orden aleatorio a los comentarios y que no se vean influenciados por ningun patron.

In [9]:
```
# Crear un vector de índices de filas aleatorios
indices_aleatorios <- sample(nrow(data))
# Mezclar las observaciones usando los índices aleatorios
data <- data[indices_aleatorios, ]
data$polarity
```

1 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 1 · 1 · 0 · 0 · 0 · 1 · 0 ·
0 · 0 · 0 · 1 · 0 · 1 · 0 · 0 · 1 · 0 · 0 · 1 · 1 · 1 · 1 · 0 · 1 · 0 · 0 · 1 · 1 · 1 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 1 · 0 · 0 ·
1 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 1 · 0 · 0 · 1 · 1 · 1 · 0 · 1 · 0 · 0 · 1 · 1 · 0 · 0 · 0 · 1 · 1 · 0 · 0 ·
1 · 0 · 0 · 0 · 0 · 1 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 1 · 0 ·
0 · 1 · 0 · 0 · 0 · 0 · 1 · 0 · 1 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 1 · 1 · 1 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 1 ·
1 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 1 · 1 · 0 · 1 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 1 ·
1 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · … · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 1 · 0 · 0 · 0 ·
1 · 1 · 0 · 1 · 0 · 1 · 0 · 0 · 0 · 1 · 1 · 0 · 0 · 1 · 1 · 0 · 0 · 0 · 1 · 1 · 1 · 0 · 0 · 0 · 1 · 1 · 0 · 0 · 1 · 1 · 0 · 1 ·
1 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 1 · 1 · 0 · 1 · 0 · 0 · 0 · 0 · 1 · 1 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 1 · 1 · 1 · 0 ·
0 · 1 · 1 · 1 · 0 · 1 · 0 · 1 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 1 · 0 · 0 · 1 · 1 · 0 ·
0 · 1 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 1 · 0 · 0 · 0 · 0 · 0 · 1 · 1 · 1 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 ·
0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 0 · 0 · 1 · 0 · 1 · 0 · 1 · 0 · 0 · 0 · 0 ·
1 · 0 · 1 · 0 · 0 · 1 · 0 · 0 · 0 · 0 · 1 · 0 · 1 · 0 · 0 · 0 · 0

▶ **Levels**:

Transformacion de los datos

En este apartado tenemos el objetivo de crear una matriz de palabras, en donde cada columna represente una palabra y cada linea contendra la observacion. Con lo cual, si la palabra de la columna 1 aparece dos veces en la observacion 10, tendremos un 2 en la fila 10 columna 1. Esto nos permitira conocer las distribuciones de las palabras, conocer cuales son las que aparecen mas y empezar a tener cierta aproximacion a los parametros comunes de todos nuestros reviews. Recordemos que el objetivo de este practico es lograr entrenar un modelo capaz de clasificar comentarios que esten cargados de sentmientos. Para esto utilizaremos dos funciones: la primera sera VectorSoruce() que nos permitira darle separabilidad a cada fila construida como si fuese un documento, y la segunda es VCorpus(), que nos permitira almacenar la coleccion de datos. Al darle una estructura matricial binaria, este almacenamiento presentara mejoras de eficiencia computacional. Ademas, el tipo de almacenamiento corpus tiene funciones que nos permiten manipular textos de forma eficiente.

In [10]:
```
data_corpus = VCorpus(VectorSource(data$review),readerControl = list(language =
print(data_corpus)
```

```
<<VCorpus>>
Metadata:  corpus specific: 0, document level (indexed): 0
Content:  documents: 891
```

Si bien, por lo que vimos a simple vista no habia mayusculas utilizadas en los reviews, igualmente pasaremos un filtro general para transformar todas las mayusculas posibles existentes en minusculas.

In [11]:
```
# Esta transformación cambia todas las mayúsculas a minúsculas
data_corpus_clean = tm_map(data_corpus, content_transformer(tolower))
# Visualización de la instancia antes y después de la transformación
print(lapply(data_corpus[[891]][1], as.character))
print(lapply(data_corpus_clean[[891]][1], as.character))
```

```
$content
[1] " very reliable syncing but......the web ui looks like it's been designed by
a college kid with a laptop.no grid view.2gb free space in 2016?wah photos look r
idiculous on  list view.the android app does nothing but getting bigger and bigge
r with each update without adding up any noticeable feature.too plain and oversim
plified ui.no download option directly to sd card."

$content
[1] " very reliable syncing but......the web ui looks like it's been designed by
a college kid with a laptop.no grid view.2gb free space in 2016?wah photos look r
idiculous on  list view.the android app does nothing but getting bigger and bigge
r with each update without adding up any noticeable feature.too plain and oversim
plified ui.no download option directly to sd card."
```

In [12]:
```
# Esta transformación retira números y palabras conectoras de lenguaje y a texto
data_corpus_clean = tm_map(data_corpus_clean, removeNumbers)
data_corpus_clean = tm_map(data_corpus_clean, removeWords, stopwords("english"))

# Visualización de la instancia antes y después de la transformación
```

```
print(lapply(data_corpus[[891]][1], as.character))
print(lapply(data_corpus_clean[[891]][1], as.character))
```

```
$content
[1] " very reliable syncing but......the web ui looks like it's been designed by
a college kid with a laptop.no grid view.2gb free space in 2016?wah photos look r
idiculous on  list view.the android app does nothing but getting bigger and bigge
r with each update without adding up any noticeable feature.too plain and oversim
plified ui.no download option directly to sd card."

$content
[1] "  reliable syncing ...... web ui looks like   designed   college kid   lapto
p. grid view.gb free space  ?wah photos look ridiculous   list view. android app
nothing  getting bigger  bigger   update without adding   noticeable feature. pla
in  oversimplified ui. download option directly  sd card."
```

Aqui vemos como transforma los comentarios para simplificar el vocabulario utilizado. Sin embargo, en este caso al eliminar "the only and" y dejar unicamente "major problem" podria desviar la review hacia una review negativa.

In [13]:
```
# sustituye puntuaciones por espacios
replacePunctuation = function(x) {gsub('[[:punct:]]', ' ', x)}

data_corpus_clean = tm_map(data_corpus_clean, replacePunctuation)
# Visualización de la instancia antes y después de la transformación
print(lapply(data_corpus[[1]][1], as.character))
print(lapply(data_corpus_clean[[1]][1], as.character))
```

```
$content
[1] "  you dont have to go to your wall calender and turn the page for your month
event...this apps is just awesome."

[[1]]
[1] "   dont   go   wall calender  turn  page   month event    apps  just awesome
"
```

In [14]:
```
#Creamos una función que sustituya las letras con acentos por letras sin acentos
removeAccents = function(x) chartr('âåäàáãèéìíòóùú', 'aaaaaeeiioouu', x)
data_corpus_clean = tm_map(data_corpus_clean, removeAccents)
print(lapply(data_corpus[[891]][1], as.character))
print(lapply(data_corpus_clean[[891]][1], as.character))
```

```
$content
[1] " very reliable syncing but......the web ui looks like it's been designed by
a college kid with a laptop.no grid view.2gb free space in 2016?wah photos look r
idiculous on  list view.the android app does nothing but getting bigger and bigge
r with each update without adding up any noticeable feature.too plain and oversim
plified ui.no download option directly to sd card."

[[1]]
[1] "  reliable syncing        web ui looks like   designed   college kid   lapto
p  grid view gb free space   wah photos look ridiculous   list view  android app
nothing  getting bigger  bigger   update without adding   noticeable feature  pla
in  oversimplified ui  download option directly  sd card "
```

In [15]:
```
#Eliminamos los signos de puntuación
data_corpus_clean <- tm_map(data_corpus_clean, removePunctuation)
```

```
print(lapply(data_corpus[[891]][1], as.character))
print(lapply(data_corpus_clean[[891]][1], as.character))
```

```
$content
[1] " very reliable syncing but......the web ui looks like it's been designed by
a college kid with a laptop.no grid view.2gb free space in 2016?wah photos look r
idiculous on  list view.the android app does nothing but getting bigger and bigge
r with each update without adding up any noticeable feature.too plain and oversim
plified ui.no download option directly to sd card."

[[1]]
[1] "  reliable syncing        web ui looks like   designed   college kid   lapto
p  grid view gb free space   wah photos look ridiculous   list view  android app
nothing  getting bigger  bigger   update without adding   noticeable feature  pla
in  oversimplified ui  download option directly  sd card "
```

In [16]:
```
# sustituye puntuaciones por espacios
replacePunctuation = function(x) {gsub('[[:punct:]]', ' ', x)}

data_corpus_clean = tm_map(data_corpus_clean, replacePunctuation)
# Visualización de la instancia antes y después de la transformación
print(lapply(data_corpus[[891]][1], as.character))
print(lapply(data_corpus_clean[[891]][1], as.character))
```

```
$content
[1] " very reliable syncing but......the web ui looks like it's been designed by
a college kid with a laptop.no grid view.2gb free space in 2016?wah photos look r
idiculous on  list view.the android app does nothing but getting bigger and bigge
r with each update without adding up any noticeable feature.too plain and oversim
plified ui.no download option directly to sd card."

[[1]]
[1] "  reliable syncing        web ui looks like   designed   college kid   lapto
p  grid view gb free space   wah photos look ridiculous   list view  android app
nothing  getting bigger  bigger   update without adding   noticeable feature  pla
in  oversimplified ui  download option directly  sd card "
```

In [17]:
```
#Elimina los dobles espacios y los sustituye por un solo espacio
data_corpus_clean = tm_map(data_corpus_clean, stripWhitespace)
# Visualización de la instancia antes y después de la transformación
print(lapply(data_corpus[[891]][1], as.character))
print(lapply(data_corpus_clean[[891]][1], as.character))
```

```
$content
[1] " very reliable syncing but......the web ui looks like it's been designed by
a college kid with a laptop.no grid view.2gb free space in 2016?wah photos look r
idiculous on  list view.the android app does nothing but getting bigger and bigge
r with each update without adding up any noticeable feature.too plain and oversim
plified ui.no download option directly to sd card."

[[1]]
[1] " reliable syncing web ui looks like designed college kid laptop grid view gb
free space wah photos look ridiculous list view android app nothing getting bigge
r bigger update without adding noticeable feature plain oversimplified ui downloa
d option directly sd card "
```

In [18]:
```
#Elimina los dobles o triples espacios y los sustituye por un solo espacio
data_corpus_clean = tm_map(data_corpus_clean, stripWhitespace)
```

```
# Visualización de la instancia antes y después de la transformación
print(lapply(data_corpus[[891]][1], as.character))
print(lapply(data_corpus_clean[[891]][1], as.character))
```

```
$content
[1] " very reliable syncing but......the web ui looks like it's been designed by
a college kid with a laptop.no grid view.2gb free space in 2016?wah photos look r
idiculous on  list view.the android app does nothing but getting bigger and bigge
r with each update without adding up any noticeable feature.too plain and oversim
plified ui.no download option directly to sd card."

[[1]]
[1] " reliable syncing web ui looks like designed college kid laptop grid view gb
free space wah photos look ridiculous list view android app nothing getting bigge
r bigger update without adding noticeable feature plain oversimplified ui downloa
d option directly sd card "
```

In [19]:
```
data_corpus_clean = tm_map(data_corpus_clean, stemDocument, 'english')
print(lapply(data_corpus[[891]][1], as.character))
print(lapply(data_corpus_clean[[891]][1], as.character))
```

```
$content
[1] " very reliable syncing but......the web ui looks like it's been designed by
a college kid with a laptop.no grid view.2gb free space in 2016?wah photos look r
idiculous on  list view.the android app does nothing but getting bigger and bigge
r with each update without adding up any noticeable feature.too plain and oversim
plified ui.no download option directly to sd card."

[[1]]
[1] "reliabl sync web ui look like design colleg kid laptop grid view gb free spa
ce wah photo look ridicul list view android app noth get bigger bigger updat with
out ad notic featur plain oversimplifi ui download option direct sd card"
```

In [20]:
```
stopwords_english <- c('i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselve
                       'you', 'your', 'yours', 'yourself', 'yourselves', 'he', '
                       'his', 'himself', 'she', 'her', 'hers', 'herself', 'it',
                       'itself', 'they', 'them', 'their', 'theirs', 'themselves'
                       'what', 'which', 'who', 'whom', 'this', 'that', 'these',
                       'those', 'am', 'is', 'are', 'was', 'were', 'be', 'been',
                       'being', 'have', 'has', 'had', 'having', 'do', 'does', 'd
                       'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'bec
                       'as', 'until', 'while', 'of', 'at', 'by', 'for', 'with',
                       'against', 'between', 'into', 'through', 'during', 'befor
                       'after', 'above', 'below', 'to', 'from', 'up', 'down', 'i
                       'out', 'on', 'off', 'over', 'under', 'again', 'further',
                       'then', 'once', 'here', 'there', 'when', 'where', 'why',
                       'how', 'all', 'any', 'both', 'each', 'few', 'more', 'most
                       'other', 'some', 'such', 'no', 'nor', 'not', 'only', 'own
                       'same', 'so', 'than', 'too', 'very', 's', 't', 'can', 'wi
                       'just', 'don', 'should', 'now', 'd', 'll', 'm', 'o', 're'
                       've', 'y', 'ain', 'aren', 'couldn', 'didn', 'doesn', 'had
                       'hasn', 'haven', 'isn', 'ma', 'mightn', 'mustn', 'needn',
                       'shan', 'shouldn', 'wasn', 'weren', 'won', 'wouldn')

# especificando un vector de palabras comunes a ser eliminadas
data_corpus_clean = tm_map(data_corpus_clean, removeWords, stopwords_english)
```

In [21]:
```
#Transforma a documentos de texto plano
data_corpus_clean = tm_map(data_corpus_clean, PlainTextDocument)
```

In [22]:
```
for (i in (1:5))
{
    print(paste0("subject number ", i))
    print(lapply(data_corpus[[i]][1], as.character))
    print(lapply(data_corpus_clean[[i]][1], as.character))
}
```

```
[1] "subject number 1"
$content
[1] "  you dont have to go to your wall calender and turn the page for your month
event...this apps is just awesome."

$content
[1] "dont go wall calend turn page month event app  awesom"

[1] "subject number 2"
$content
[1] " awesome it's a great game that will test your patience. you may have to spe
nd real money if you can't wait to move on or lack the skill needed to complete a
stage. there are more than 1,000 stages, so far i'm up to level 82 and each level
has at least 15 stages."

$content
[1] "awesom great game  test patienc may spend real money wait move lack skill ne
ed complet stage stage far level level least stage"

[1] "subject number 3"
$content
[1] "  is a shame that when you share picture with your contact all people that h
as google account sees all the pictures and those pictures supposed to be a priva
te picture that was shared between contact.  Ä‘ÂŸÂ\230Ä…Ä‘ÂŸÂ\230Ä…Ä‘ÂŸÂ\230Ä…"

$content
[1] "shame share pictur contact peopl googl account see pictur pictur suppos priv
at pictur share contact ‘aÿa\230…‘aÿa\230…‘aÿa\230…"

[1] "subject number 4"
$content
[1] " samsung note 4 - awesome business platform! please consider adding an edit
option in addition to delete for our posts. just in case we'd like to correct a m
istake, rather than delete the whole thing."

$content
[1] "samsung note awesom busi platform pleas consid ad edit option addit delet po
st  case like correct mistak rather delet whole thing"

[1] "subject number 5"
$content
[1] " ugh i don't recommend this because when i tried getting into the game it sa
ys that it's downloading but it really isn't and then it doesn't work and i cant
play it!. i was so excited to play the game but it just doesn't work for me!!"

$content
[1] "ugh recommend tri get game say download realli work cant play excit play gam
e  work"
```

Vemos como nos simplifica muchisimo nuestras reviews. Sin embargo, tenemos perdidas a niveles estructurales. Para el caso de la subject number 2, vemos por ejemplo que nothing fue cambiada por noth, ya que saco su ing que es un componente verbal, pero que en este caso no toma es representacion, como asi tambien el caso de de issues "problemas", cuando le quita el plural borra la e que corresponde a la anatomia del singular de la palabra "issue". Igualmente, no deja de ser util este filtro para normalizar nuestro data set y poder agrupar en menor cantidad de columnas nuestras palabras. (perdi el comentario porque en principio estaba mezclando los datos para tener un orden aleatorio. Sin embargo, no deja de ser util el comentario).

In [23]:
```
# Define el color personalizado
mi_color <- "#731448"

# Ajusta el tamaño del dispositivo gráfico
options(repr.plot.width=20, repr.plot.height=14)  # Puedes ajustar estos valores

# Crea la nube de palabras con el color personalizado
wordcloud(words = data_corpus_clean,
          max.words = 30,
          random.order = FALSE,
          colors = mi_color,  # Usa el color personalizado
          scale = c(6, 1),  # Ajusta el rango de tamaño de las palabras
          min.freq = 5,  # Establece la frecuencia mínima para que una palabra a
          random.color = TRUE,  # Asigna colores aleatorios a las palabras
          rot.per = 0.3,  # Proporción de palabras giradas
          use.r.layout = FALSE  # Usa el algoritmo de diseño rápido
)

# Ajusta el tamaño de la letra del título
title("Nube de Palabras - Reviews", cex.main = 2)  # Puedes ajustar el valor de
```

Para mejorar la calidad de nuestro analisis, procedemos a limpiar los emojis del texto. Al eliminar estos caracteres especiales, garantizamos que nuestro conjunto de datos este compuesto principalmente por palabras, lo que nos permite realizar un analisis más preciso y detallado. Esta accion nos ayuda a optimizar nuestro proceso de analisis y a obtener resultados mas confiables y significativos. Ademas, volvemos a realizar todos los pasos anteriores pero ahora de manera conjunta:

In [24]:
```
replacePunctuation = function(x) {gsub('[[:punct:]]', ' ', x)}
removeAccents = function(x) chartr('âåäàáèëéìíòóùúÿ', 'aaaaaeeeiioouuy', x)
eliminar_emojis <- function(texto) {
  texto_sin_emojis <- gsub("[^[:alnum:][:space:]]", '', texto)
  return(texto_sin_emojis)
}

clean_corpus = function(corpus){
                data_corpus_clean = tm_map(corpus, content_transformer(tolower))
                data_corpus_clean = tm_map(data_corpus_clean, removeNumbers)
                data_corpus_clean = tm_map(data_corpus_clean, removeWords, stopwo
                data_corpus_clean = tm_map(data_corpus_clean, removePunctuation)
                data_corpus_clean = tm_map(data_corpus_clean, replacePunctuation)
                data_corpus_clean = tm_map(data_corpus_clean, removeAccents)
                data_corpus_clean = tm_map(data_corpus_clean, stripWhitespace)
                data_corpus_clean = tm_map(data_corpus_clean, removeWords, stopwo
                data_corpus_clean = tm_map(data_corpus_clean, stemDocument, 'engl
                data_corpus_clean = tm_map(data_corpus_clean, eliminar_emojis)
                data_corpus_clean = tm_map(data_corpus_clean, PlainTextDocument)
  return(data_corpus_clean)
}
```

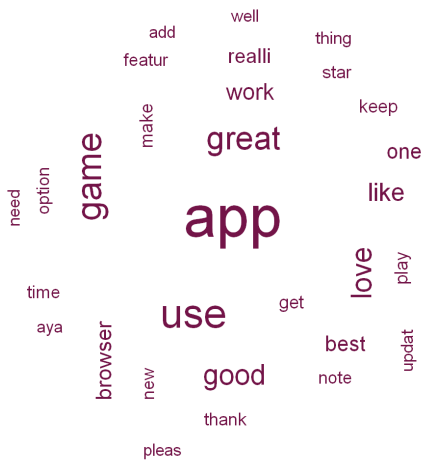
In [25]:
```
data_corpus_clean = clean_corpus(data_corpus)
print(lapply(data_corpus[[i]][1], as.character))
print(lapply(data_corpus_clean[[i]][1], as.character))
```

```
$content
[1] " ugh i don't recommend this because when i tried getting into the game it sa
ys that it's downloading but it really isn't and then it doesn't work and i cant
play it!. i was so excited to play the game but it just doesn't work for me!!"

$content
[1] "ugh recommend tri get game say download realli work cant play excit play gam
e work"
```

In [26]:
```
data_subject_noneutral = subset(data, data$polarity =='1')
data_corpus_noneutral = VCorpus(VectorSource(data_subject_noneutral$review),read
data_corpus_clean_noneutral = clean_corpus(data_corpus_noneutral)

wordcloud(data_corpus_clean_noneutral,
          max.words = 30,
          random.order = FALSE,
          colors = mi_color,  # Usa el color personalizado
          scale = c(6, 1),  # Ajusta el rango de tamaño de las palabras
          min.freq = 5,  # Establece la frecuencia mínima para que una palabra a
          random.color = TRUE,  # Asigna colores aleatorios a las palabras
          rot.per = 0.3,  # Proporción de palabras giradas
          use.r.layout = FALSE  # Usa el algoritmo de diseño rápido
)
```



Entrenamos y validamos nuestro modelo

In [27]:
```
dtm = DocumentTermMatrix(data_corpus_clean)
dtm
```

```
<<DocumentTermMatrix (documents: 891, terms: 2766)>>
Non-/sparse entries: 16152/2448354
Sparsity           : 99%
Maximal term length: 29
Weighting          : term frequency (tf)
```

In [28]:
```
str(dtm)
```

```
List of 6
 $ i       : int [1:16152] 1 1 1 1 1 1 1 1 1 2 ...
 $ j       : int [1:16152] 125 187 363 695 801 1542 1724 2517 2659 187 ...
 $ v       : num [1:16152] 1 1 1 1 1 1 1 1 1 1 ...
 $ nrow    : int 891
 $ ncol    : int 2766
 $ dimnames:List of 2
  ..$ Docs : chr [1:891] "character(0)" "character(0)" "character(0)" "character
(0)" ...
  ..$ Terms: chr [1:2766] "aafnaii" "aakhirat" "aalikati" "aap" ...
 - attr(*, "class")= chr [1:2] "DocumentTermMatrix" "simple_triplet_matrix"
 - attr(*, "weighting")= chr [1:2] "term frequency" "tf"
```

In [29]:
```
as.matrix(dtm)
```

A matrix: 891 × 2766 of type d

	aafnaii	**aakhirat**	**aalikati**	**aap**	**aapsssssss**	**aaru**	**abil**	**abk**	**abl**	**absolut**	**...**
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	1	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	1	1	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	1	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	1	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	1	0	...
...	...	...	...	...	...	...	...	...	...	...	
character(0)	0	0	0	0	0	0	0	0	0	0	...

	aafnaii	aakhirat	aalikati	aap	aapsssssss	aaru	abil	abk	abl	absolut	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	1	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	1	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...
character(0)	0	0	0	0	0	0	0	0	0	0	...

In [70]:

```
#Establecemos las frecuencias de cada término sumando las columnas
termFreq = colSums(as.matrix(dtm))
#print(termFreq) no haremos este printo porque aporta muchas paginas al document
```

In [31]:
```
#Creamos el nuevo data set
tabla_frec = data.frame(term = names(termFreq), freq = termFreq)
tail(tabla_frec)
```

A data.frame: 6 × 2

	term	freq
	<chr>	<dbl>
yrs	yrs	2
yup	yup	1
zenfon	zenfon	2
zero	zero	1
zespol	zespol	1
zoom	zoom	4

In [32]:
```
#Ordenamos por frecuencias descendientes
tabla_frec = tabla_frec[order(-tabla_frec[,2]),]
head(tabla_frec)
```

A data.frame: 6 × 2

	term	freq
	<chr>	<dbl>
app	app	480
use	use	299
updat	updat	243
game	game	179
work	work	176
fix	fix	171

In [33]:
```
set.seed(33)

# Creamos el data partition de la función caret con un 70 - 30 split
inTrain <- createDataPartition(y = data$polarity
                               , p = .70
                               , list = FALSE
                               , times = 1)
# Definitmos los datasets originales entre train y test
data.train<-data[inTrain,]
data.test<-data[-inTrain,]
# Revisamos el split
str(data.train)
str(data.test)
```

```
'data.frame':   624 obs. of  3 variables:
 $ review    : chr  "  you dont have to go to your wall calender and turn the pag
e for your month event...this apps is just awesome." " awesome it's a great game
that will test your patience. you may have to spend real money if you can't wait
to "| __truncated__ "  is a shame that when you share picture with your contact a
ll people that has google account sees all the pict"| __truncated__ " samsung not
e 4 - awesome business platform! please consider adding an edit option in additio
n to delete for ou"| __truncated__ ...
 $ polarity  : Factor w/ 2 levels "0","1": 2 2 1 1 1 1 1 1 1 ...
 $ aplicacion: chr  "com.hamropatro" "com.king.candycrushsaga" "com.google.androi
d.talk" "com.linkedin.android" ...
'data.frame':   267 obs. of  3 variables:
 $ review    : chr  " â\220â\220â\220 when will this app be created to automatica
lly start at the top with new posts instead of h"| __truncated__ " great way to s
tay organized i jot notes for work, family, shopping lists, music , things to do
and stories or "| __truncated__ " great game, really dislike the ads. i usually d
on't  write reviews, but this time i am because it's getting  r"| __truncated__ "
err... how do i back up and restore chat history? i used to be able to do that in
older versions. why would y"| __truncated__ ...
 $ polarity  : Factor w/ 2 levels "0","1": 1 2 1 1 1 1 1 1 1 ...
 $ aplicacion: chr  "com.twitter.android" "com.evernote" "com.rovio.angrybirds"
"com.tencent.mm" ...
```

In [34]:
```
# Separamos el corpus según la clase
corpus.train = data_corpus_clean[inTrain]
corpus.test  = data_corpus_clean[-inTrain]

# Y finalmente el Document term matrix
dtm.train = dtm[inTrain, ]
dtm.test  = dtm[-inTrain, ]

# Comprobamos que el desbalanceo de clases es el adecuado
print("Training")
round(prop.table(table(data.train$polarity))*100, 2)
print("Test")
round(prop.table(table(data.test$polarity))*100, 2)
```

```
[1] "Training"
    0     1
65.54 34.46
[1] "Test"
    0     1
65.54 34.46
```

In [35]:
```
#Encontramos todas las palabras que se repiten más de 3 veces
freq_terms = findFreqTerms(dtm.train, 3)
freq_terms
```

'abil' · 'abl' · 'absolut' · 'access' · 'account' · 'achiev' · 'action' · 'activ' · 'actual' · 'add' · 'addict' · 'address' · 'adjust' · 'advertis' · 'age' · 'ago' · 'aint' · 'allow' · 'almost' · 'along' · 'alreadi' · 'also' · 'alway' · 'amaz' · 'among' · 'amount' · 'android' · 'angri' · 'anim' · 'annoy' · 'anoth' · 'answer' · 'anymor' · 'anyon' · 'anyth' · 'aºa' · 'app' · 'appeal' · 'appear' · 'appli' · 'applic' · 'appreci' · 'around' · 'artifact' · 'asap' · 'ask' · 'aspect' · 'asus' · 'atleast' · 'attack' · 'audio' · 'auto' · 'automat' · 'avail' · 'averag' · 'away' · 'awesom' · 'awsom' · 'aya' · 'ayaay' · 'back' · 'background' · 'backup' · 'bad' · 'bar' · 'base' · 'basic' · 'batteri' · 'beauti' · 'becom' · 'begin' · 'behind' · 'best' · 'beta' · 'better' · 'big' · 'bird' · 'bit' · 'black' · 'blank' · 'block' · 'book' · 'bookmark' · 'boost' · 'booster' · 'bore' · 'bottom' · 'box' · 'break' · 'brilliant' · 'bring' · 'brows' · 'browser' · 'bug' · 'buggi' · 'build' · 'busi' · 'button' · 'buy' · 'cach' · 'calendar' · 'call' · 'camera' · 'candi' · 'cant' · 'cap' · 'capit' · 'captur' · 'card' · 'care' · 'carousel' · 'caus' · 'certain' · 'challeng' · 'chang' · 'charact' · 'chat' · 'check' · 'choic' · 'choos' · 'christma' · 'chrome' · 'clan' · 'classic' · 'cleaner' · 'clear' · 'click' · 'close' · 'cloud' · 'clutter' · 'code' · 'color' · 'come' · 'comment' · 'communic' · 'compani' · 'compar' · 'compat' · 'complain' · 'complaint' · 'complet' · 'comput' · 'con' · 'concern' · 'confus' · 'connect' · 'constant' · 'contact' · 'content' · 'continu' · 'control' · 'convers' · 'cool' · 'copi' · 'countri' · 'coupl' · 'coz' · 'crap' · 'crash' · 'crazi' · 'creat' · 'crush' · 'current' · 'custom' · 'cut' · 'daili' · 'dark' · 'data' · 'day' · 'dead' · 'dear' · 'default' · 'definit' · 'delet' · 'deliv' · 'design' · 'desir' · 'desktop' · 'destroy' · 'detail' · 'dev' · 'develop' · 'devic' · 'differ' · 'difficult' · 'direct' · 'dis' · 'disabl' · 'disappear' · 'disappoint' · 'display' · 'document' · 'doesnt' · 'done' · 'dont' · 'doubt' · 'download' · 'drain' · 'drive' · 'drop' · … · 'save' · 'say' · 'score' · 'screen' · 'scroll' · 'search' · 'second' · 'secur' · 'see' · 'seem' · 'seen' · 'select' · 'send' · 'sens' · 'sent' · 'separ' · 'serious' · 'servic' · 'set' · 'sever' · 'shake' · 'share' · 'shield' · 'shop' · 'short' · 'show' · 'shown' · 'shut' · 'sight' · 'sign' · 'signal' · 'similar' · 'simpl' · 'simpli' · 'sinc' · 'singl' · 'site' · 'size' · 'skill' · 'skype' · 'slack' · 'slow' · 'slower' · 'small' · 'smooth' · 'sms' · 'softwar' · 'solv' · 'someon' · 'someth' · 'sometim' · 'soon' · 'sorri' · 'sort' · 'sound' · 'space' · 'spam' · 'speaker' · 'specif' · 'speed' · 'spend' · 'spin' · 'stabl' · 'stage' · 'star' · 'start' · 'status' · 'stay' · 'stick' · 'sticker' · 'still' · 'stop' · 'storag' · 'store' · 'stuck' · 'stuff' · 'submit' · 'success' · 'suck' · 'sudden' · 'suggest' · 'super' · 'supercel' · 'support' · 'suppos' · 'sure' · 'swipe' · 'switch' · 'sync' · 'system' · 'tab' · 'tablet' · 'tag' · 'take' · 'taken' · 'talk' · 'tap' · 'task' · 'team' · 'telegram' · 'tell' · 'templ' · 'terribl' · 'test' · 'text' · 'thank' · 'that' · 'theme' · 'therefor' · 'thing' · 'think' · 'third' · 'though' · 'thought' · 'till' · 'time' · 'timelin' · 'togeth' · 'took' · 'tool' · 'top' · 'total' · 'touch' · 'town' · 'transfer' · 'tri' · 'troop' · 'troubl' · 'turn' · 'tweet' · 'twice' · 'twitter' · 'two' · 'type' · 'ubuntu' · 'unabl' · 'unfortun' · 'uninstal' · 'unless' · 'unlock' · 'unstabl' · 'unus' · 'updat' · 'upgrad' · 'upload' · 'upon' · 'usag' · 'use' · 'useless' · 'user' · 'usual' · 'version' · 'via' · 'viber' · 'video' · 'view' · 'voic' · 'wait' · 'wallet' · 'wanna' · 'want' · 'wast' · 'watch' · 'way' · 'web' · 'webpag' · 'websit' · 'wechat' · 'week' · 'well' · 'went' · 'whatev' · 'whatsapp' · 'whenev' · 'whether' · 'white' · 'widget' · 'wifi' · 'window' · 'wish' · 'within' · 'without' · 'wonder' · 'wont' · 'word' · 'work' · 'world' · 'wors' · 'worst' · 'worth' · 'write' · 'wrong' · 'wtf' · 'wth' · 'xperia' · 'year' · 'yes' · 'yet' · 'youtub' · 'zoom'

In [36]:
```
#Recortamos el data set con las palabras con una frecuencia superior a 3
freq_terms = findFreqTerms(dtm.train, 3)
reduced_dtm.train = DocumentTermMatrix(corpus.train, list(dictionary=freq_terms))
reduced_dtm.test =  DocumentTermMatrix(corpus.test, list(dictionary=freq_terms))

#Revisamos cuantas columnas reducimos
ncol(dtm.train)
```

```
ncol(reduced_dtm.train)
ncol(dtm.test)
ncol(reduced_dtm.test)
```

2766

835

2766

835

Clasificador Naive Bayes

Naive Bayes es un algoritmo de aprendizaje supervisado usado para clasificacion y modelado predictivo. Funciona calculando la probabilidad condicional de que una instancia pertenezca a una clase especifica dado un conjunto de caracteristicas observadas previamente. Este modelo hace una suposicion simplificada de independencia condicional entre las caracteristicas, lo que significa que asume independencia entre si dado el valor de la clase.

In [37]:
```
convert_counts = function(x) {
  x = ifelse(x > 0, 1, 0)
  x = factor(x, levels = c(0, 1), labels=c("Nulo", "No Nulo"))
  return (x)
}

# apply() allows us to work either with rows or columns of a matrix.
# MARGIN = 1 is for rows, and 2 for columns
reduced_dtm.train = apply(reduced_dtm.train, MARGIN=2, convert_counts)
reduced_dtm.test  = apply(reduced_dtm.test, MARGIN=2, convert_counts)
```

In [38]:
```
# Almacena nuestro modelo en subject_classifier
subject_classifier <- naiveBayes(x = reduced_dtm.train,  # Dataset de entrenamie
                                 y = data.train$polarity)  # Target de entrenam

# Realiza predicciones utilizando el modelo creado con los datos de entrenamient
subject_test.predicted <- predict(subject_classifier,  # Modelo
                                  newdata = reduced_dtm.test)  # Dataset de test
```

In [39]:
```
# Ahora sacamos el confusion matrix
confusionMatrix(subject_test.predicted, data.test$polarity)
```

```
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0 148  21
         1  27  71

               Accuracy : 0.8202
                 95% CI : (0.7688, 0.8644)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 1.822e-09

                  Kappa : 0.608

 Mcnemar's Test P-Value : 0.4705

            Sensitivity : 0.8457
            Specificity : 0.7717
         Pos Pred Value : 0.8757
         Neg Pred Value : 0.7245
             Prevalence : 0.6554
         Detection Rate : 0.5543
   Detection Prevalence : 0.6330
      Balanced Accuracy : 0.8087

       'Positive' Class : 0
```

Con una simple limpieza estructural de las reviews hemos conseguido un accuracy de aproximadamente un 82%. Veamos que sucede con nuestros errores de tipo I y errores de tipo II para comprender nuestros errores de prediccion:

In [40]:
```
# Visualizamos las instancias que han sido filtradas erróneamente
data.test[(subject_test.predicted != data.test$polarity) # Seleccionamos las ins
          & (data.test$polarity == '1'),] # Seleccionamos las instancias con eti
```

A data.frame: 21 ×

603	the most useful app in the marketplace if used properly . . . if you've ever thought how nice it in your life and yet still have it available anytime/all the time using powerful searches, then eve store it; scan paper using your smart phone or scanner and store it all in a note; forwa computer files, create a note using your finger in handwriting or text mode,
888	all time legendary game the birthday party levels and short fuse levels are fantastic.especially just great.suggestion to all those players who cringe about too much ads is close ur wi-fi cc
343	i love viber viber is an excellent chatting software. only one tiny negative comment for you. sor
795	i've used firefox on all my mobile devices and computers for years, but since this latest update links either don't work or take you to a different link on the page and the tops & bottoms of pa page is visible and search boxes can't be accessed. i hate the idea of changing to chrome e
441	occasionally i won't receive a notification of a message(s) so i don't know that someone ha suddenly lots of messa
839	
483	works fine for the most part. not sure why it decides to sometimes notify me and sometimes nc on other logged in devices (i'm usually
224	know how to get the account back. you have to delete clash of clans,then you download it again screen, then you see already have a village?'' t
126	memory game the levels are so hard and less moves . I do no how to pass 95 levels but lev
529	just one irritating issue very nice app... except one issue. there is no option of select all for pho individually. and there is no option to download or make offline the entire f
516	extremely useful app, but has a tendency every so often to glitch out and eat half my battery b users define a cap on how much device storage it can hog; i recently discovered this app e internal storage, all on its own. i now clear
587	widget sabotaged this app functions ok as a note-taker. i access it primarily through its widg few recent notes. then that widget was killed off, and replaced with a widget that shows only t of the title of a third note, and no content at all. it shows poor judgment for a company to
625	uc hello uc browser i start uc browser it s open when i type search bar web address it s loading vpn its working well it happ
869	smart and fun i'm late to the party. if i knev
791	very good, but reposition and either fix or remove the 'share link' button. the 'bookmarks r been happy with this app for a while now, i just forgot to change my previous review. that isn't having gotten used to chrome, i find myself pressing 'share link' rather than 'open link in new pressing 'share link' causes the app to crash. please either fix this issue and repo
480	makes everything so easy slack is easy to use and has all the right (ridiculously well polished and honest team. it almost seems like they want you to be happy
264	good... chrome is improving...! but there are some problems 1)we can't change the default dov web pages for offline

705	superfast, just as i remember it ! opera mini was the #1 browser back in the days of symbian minimal data used. as opposed to chrome which is starting to stutter , lag,
114	groups??? ** edit: i changed my rating from one to three stars due to linkedin's response to dont iike that it is n
176	it's alrightÄ‘ÂŸÂ˜Â¤ i don't get to go why.„Ä‘ÂŸÂ˜Ë˜Ä‘ÂŸÂ‘Â€Ä‘ÂŸÂ‘Â€Ä‘ÂŸÂ‘Â€Ä‘ÂŸÂ‘Â€Ã¢ÂšÂ Ã¢ÂšÂ Ã¢ÂšÂ Ä‘ÂŸÂ‰ÂŒÄ‘ÂŸÂˆÄ¾Ä‘Â forg
593	too much going on its cool it works but ony using it because i have to its got way to much goir information like i made a note on a friends birthday now it says from so and sos birthday bu note pad like the one htc used this app to replace. if there was a way to over complicate a n and it ta

In [41]:
```
# Visualizamos las instancias que han sido filtradas erróneamente, los comentari
data.test[(subject_test.predicted != data.test$polarity)
          & (data.test$polarity == '0'),]
```

A data.frame: 27 × 3

	review	polarity	aplicacion
	<chr>	<fct>	<chr>
531	bait and switch i purchased my 3rd samsung tablet with advertisement of free gifts, one of them being 48 additional gb cloud storage for 2 years. the 2nd samsung tablet i bought also had this free gift and it was a nightmare to get samsung and dropbox to honor it. so, after buying this 3rd high end tablet with the same claim of the free 48gb for 2 years in the fine print, which you can only see after purchasing the tablet, dropbox only honors the offer on the first device you purchased and you are disqualified for all future devices. this is sleazy and bait and switch. free= not subject to any compensation, encumbrance, repayment in kind, etc. because of this bait and switch advertising on the part of samsung and dropbox i suggest you really find out what kind of company dropbox is before using their services.	0	com.dropbox.android
643	neat nice ,smooth ,speed but downloading is lacking in speed correct this i'll give u 5 star	0	com.uc.browser.en
760	ads? really? ads in the kantipur app? you guys so down to earn money?	0	com.shirantech.kantipur
506	need swipe between images nice app, but it would be really nice if you could swipe between images when viewing them full size.	0	com.Slack
373	often painfully slow. needs a useful tablet ui, quick reply, and the ability to send video. some of these are features the ios version has had for almost 2 years and that isn't really excusable from the company that runs android. this is the kind of thing that makes people switch to ios or makes android phone lovers buy ipads instead of android tablets.	0	com.google.android.talk
498	rewelacja bardzo uÄºÅºyteczne narzÃ¤Â™dzie do komunikacji w zespole!	0	com.Slack
193	always fun, but... i like this new frozen shadows, but the depth perception is not so good. it's hard to see an approaching corner. other then that small bug, i love this game and will continue to play it.	0	com.imangi.templerun2
132	lost power ups switched phones and lost my power ups. i had accumulated quite a lot. how do i get them back.	0	com.king.candycrushsaga
199	temple run 2 frozen shadows i love this game so much i love being in the ice but only one thing that i hate about it is that the monster goes infront of u when your running but as you go further into the game it gets harder but able to pass the monster	0	com.imangi.templerun2
104	doesn't work challenge page fails to load. it's so secure even i can't get in.	0	com.linkedin.android

	review	polarity	aplicacion
	<chr>	<fct>	<chr>
722	best browser but keeps crashing i've no clue but my browser keeps on crashing for unknown reason..even while browsing on simplest of websites..this is after the previous update. updating again hopefully it goes away	0	com.opera.mini.native
175	the new theme is not compatible with my device :((samsung galaxy j1) make it compatible please. i really love this game.	0	com.imangi.templerun2
756	too much pop up add	0	com.shirantech.kantipur
522	good but not great app is awesome, saves me a ton of memory. but i think it should add a few more features to make use even better... 1) you should had a select all button when moving upload pics to dropbox albums. its a real pain checking individually 250 pictures to move to album. 2.) once pictures are in album, the thumnail should sell you how many pictures are currently in that album... if you could do those 2 things... it would be Ã¢Â˜Â†Ã¢Â˜Â†Ã¢Â˜Â†Ã¢Â˜Â†Ã¢Â˜Â†	0	com.dropbox.android
484	when you repeat over and over that you support animated gifs now, maybe a good idea would be to actually support them.	0	com.Slack
80	the new app looks great and is very easy to use. however it is missing important features such as endorsing connections or writing recommendations. furthermore i hate the fact that job search is now in a separate app. why do i have to download 2 apps?	0	com.linkedin.android
782	firefox is getting better ... slowly it crashes regularly. it doesn't play video on youtube. otherwise it is a promising fast browser, i still miss the gestures/swipes and a well organized homepage with my selected bookmarks (see ucbrowser hd)	0	org.mozilla.firefox
653	sound decrease issue when i play a video in uc player its 100% sound is equal to my device 60% sound. why sound is decreased in uc mini and shows full volume	0	com.uc.browser.en
75	so much room for improvement... the twitter app has been around for several years and yet it still hasn't lived up to its full potential. here's an example: how don't we have the capability to save gifs and videos? not only that, but it'd be cool if we can customize and have different layouts and appearances. simple updates like those would make this app so much better, not lame ones like changing favorites to likes. hopefully these ideas can be considered for 2016.	0	com.twitter.android
181	not supported your new updated temple run 2 frozen shadows map is not supported to my device which is the samsung galaxy v. ill give 5 stars if you	0	com.imangi.templerun2

	review	polarity	aplicacion
	<chr>	<fct>	<chr>
	will make this updated map support my device plss i need to play that map, ive been waiting this for a couple of months		
566	dud on droid4 doesn't work on my new droid4	0	jabanaki.todo.todoly
621	disappointed first of all i'd like to thank the creators of the uc browser for this is the best browser that i have ever used. now why 3 stars ,because i was planning to download a game but uc browser can't download it. the page loads but no downloads and i have to use mozilla because of this particular reason..i want to give you guys a five star but until you fix this i will just give you 3 star...thank you ....just please help me with this one i want to use only one browser.	0	com.uc.browser.en
860	way to ruin it. this game was good at one point. i supported this game with real money. if you can't say anything nice: i hope other people can find a good time playing this.	0	com.rovio.angrybirds
119	totally diferent from the web page do not use this app, use the web page instead, you will be able to do much more from there. it is almost impossible to apply to a job from here.	0	com.linkedin.android
601	confusing i used the app to import important notes from another smartphone note book to my current phone. although it transferred the information, it is so hard to find it. ..it disappeared completely	0	com.evernote
540	not enough space 6g is nothing these days. need at least 32g to store all the memory hungry apps as every update gets bigger and bigger as the quality and functionality get smaller and smaller. please dont go to that material crap !!! not evertone likes the cheap material design. it is designed for lazy devs who like the easy/lazy way	0	com.dropbox.android
758	please add option to provide pdf versions to download in mobile/tabs.	0	com.shirantech.kantipur

In [48]:
```
data_subject_eC = read.csv(file='sentiment_dataset.csv', header=TRUE)
head(data_subject_eC)
tail(data_subject_eC)
```

A data.frame: 6 × 3

	ï..package_name	review	polarity
	<chr>	<chr>	<int>
1	com.facebook.katana	privacy at least put some option appear offline. i mean for some people like me it's a big pressure to be seen online like you need to response on every message or else you be called seenzone only. if only i wanna do on facebook is to read on my newsfeed and just wanna response on message i want to. pls reconsidered my review. i tried to turn off chat but still can see me as online.	0
2	com.facebook.katana	messenger issues ever since the last update, initial received messages don't get pushed to the messenger app and you don't get notification in the facebook app or messenger app. you open the facebook app and happen to see you have a message. you have to click the icon and it opens messenger. subsequent messages go through messenger app, unless you close the chat head... then you start over with no notification and having to go through the facebook app.	0
3	com.facebook.katana	profile any time my wife or anybody has more than one post and i view them it would take me to there profile so that i can view them all at once. now when i try to view them it tells me that the page that i requested is not available. i've restarted my phone i even cleard the cache and i've uninstalled and reinstalled the app and it is still doing it. please fix it thank you	0
4	com.facebook.katana	the new features suck for those of us who don't have a working back button can you guys make the videos able to be slid to the left to exit the video. as i have to force close facebook to exit	0
5	com.facebook.katana	forced reload on uploading pic on replying comment last night i tried to reply a comment by uploading a photo from my phone. when i press on the button to select photos the app automatically goes back to the main page. on other occasions, i could enter to my gallery to select my image but as soon as i selected an image and press done, the program, again, forced reload and suddenly go back to the main page. please fix this and i will change my rating. thank you.	0
6	com.facebook.katana	idk i can't edit my posts? things such as my profile picture, when i edit it, it becomes grey and says that it is no longer available. please fix. i have an htc desire. will rate 5 stars shown fixed Ä‘ÂŸÂ˜Â”	0

A data.frame: 6 × 3

	ï..package_name	review	polarity
	<chr>	<chr>	<int>
886	com.rovio.angrybirds	too many ads far more adverts than any other game i've played. i know it's free and they need the ads to make a profit but there needs to be a balance.	1
887	com.rovio.angrybirds	loved it i looooooooooooooovvved it because it is incredible awesome and it's in go power and make a new clash of clans the same thing butt better	1
888	com.rovio.angrybirds	all time legendary game the birthday party levels and short fuse levels are fantastic.especially when the pigs crash onto different chemicals is just great.suggestion to all those players who cringe about too much ads is close ur wi-fi connection and then play the game.then the ads won't trouble you.	1
889	com.rovio.angrybirds	ads are way to heavy listen to the bad reviews. there are ads after every round, whether you pass it or fail it. sometimes there are ads before the next round starts to. you spend more time on ads than game play. i develop web apps, and honestly many people rely on ads to make a living. i can appreciate that all to well. however, these developers have went far beyond that. frankly, they are disrespectful nitwits.	0
890	com.rovio.angrybirds	fun works perfectly well. ads aren't as annoying as you think, especially for a free game.	1
891	com.rovio.angrybirds	they're everywhere i see angry birds everywhere because i can't stop playing this game. get out my head devs! 4 Ä'ÂŸÂŒÂŸ because nothing's perfect	1

In [49]:
```
data_corpus_eC = VCorpus(VectorSource(data_subject_eC$review),readerControl = li
print(data_corpus_eC)
```

```
<<VCorpus>>
Metadata:  corpus specific: 0, document level (indexed): 0
Content:  documents: 891
```

In [52]:
```
replacePunctuation = function(x) {gsub('[[:punct:]]', ' ', x)}
removeAccents = function(x) chartr('âåäàáèëéìíòóùúÿ', 'aaaaaeeeiioouuy', x)
eliminar_emojis <- function(texto) {
  texto_sin_emojis <- gsub("[^[:alnum:][:space:]]", '', texto)
  return(texto_sin_emojis)
}

clean_corpus= function(corpus){
               data_corpus_clean = tm_map(corpus, content_transformer(tolower))
               data_corpus_clean = tm_map(data_corpus_clean, removeNumbers)
               data_corpus_clean = tm_map(data_corpus_clean, removeWords, stopwo
               data_corpus_clean = tm_map(data_corpus_clean, removePunctuation)
               data_corpus_clean = tm_map(data_corpus_clean, replacePunctuation)
               data_corpus_clean = tm_map(data_corpus_clean, removeAccents)
               data_corpus_clean = tm_map(data_corpus_clean, stripWhitespace)
               data_corpus_clean = tm_map(data_corpus_clean, removeWords, stopwo
               data_corpus_clean = tm_map(data_corpus_clean, stemDocument, 'engl
               data_corpus_clean = tm_map(data_corpus_clean, eliminar_emojis)
```

```
                data_corpus_clean = tm_map(data_corpus_clean, PlainTextDocument)
  return(data_corpus_clean)
}

data_corpus_clean_eC = clean_corpus(data_corpus_eC)
```

In [53]:
```
dtm_eC = DocumentTermMatrix(data_corpus_clean_eC)
dtm_eC
```

```
<<DocumentTermMatrix (documents: 891, terms: 2766)>>
Non-/sparse entries: 16152/2448354
Sparsity           : 99%
Maximal term length: 29
Weighting          : term frequency (tf)
```

In [54]:
```
reduced_dtm_eC_predict = apply(dtm_eC, MARGIN=2, convert_counts)
```

In [55]:
```
subject_test.predicted = predict(subject_classifier,  # Predicciones utilizando
                                 reduced_dtm_eC_predict)
```

In [56]:
```
round(prop.table(table(subject_test.predicted))*100, digits = 1)
```

```
subject_test.predicted
   0    1
61.7 38.3
```

In [64]:
```
data_subject_eCpredict=cbind(data_subject_eC,subject_test.predicted)
data_subject_eCpredict_s <- subset(data_subject_eCpredict, subject_test.predicte
```

Laplace Smoothing

El suavizado de Laplace es una tecnica que se puede utilizar en la clasificación de texto con el algoritmo de Naive Bayes. Esta herramienta ayuda a resolver el problema de la probabilidad cero, que puede surgir cuando una palabra presente en el conjunto de prueba no esta en el conjunto de entrenamiento. Este problema toma una mayor relevancia cuando tratamos con un texto de amplio vocabulario.

In [63]:
```
# Hacemos una iteración para nuestro modelo en base a un factor i, siendo i el f
for (i in (1:10))
{
    print(paste0("Laplace factor of ", as.character((i-1)/4)))
    sms_classifier2 = naiveBayes(x = reduced_dtm.train,
                                 y = data.train$polarity,
                                laplace = (i-1)/2)
    sms_test.predicted2 = predict(sms_classifier2,
                                  reduced_dtm.test)

    print(confusionMatrix(sms_test.predicted2, data.test$polarity))
}
```

```
[1] "Laplace factor of 0"
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0 148  21
         1  27  71

               Accuracy : 0.8202
                 95% CI : (0.7688, 0.8644)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 1.822e-09

                  Kappa : 0.608

 Mcnemar's Test P-Value : 0.4705

            Sensitivity : 0.8457
            Specificity : 0.7717
         Pos Pred Value : 0.8757
         Neg Pred Value : 0.7245
             Prevalence : 0.6554
         Detection Rate : 0.5543
   Detection Prevalence : 0.6330
      Balanced Accuracy : 0.8087

       'Positive' Class : 0

[1] "Laplace factor of 0.25"
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0 129  13
         1  46  79

               Accuracy : 0.779
                 95% CI : (0.7244, 0.8273)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 7.416e-06

                  Kappa : 0.5491

 Mcnemar's Test P-Value : 3.099e-05

            Sensitivity : 0.7371
            Specificity : 0.8587
         Pos Pred Value : 0.9085
         Neg Pred Value : 0.6320
             Prevalence : 0.6554
         Detection Rate : 0.4831
   Detection Prevalence : 0.5318
      Balanced Accuracy : 0.7979

       'Positive' Class : 0

[1] "Laplace factor of 0.5"
Confusion Matrix and Statistics

          Reference
```

```
Prediction   0   1
         0 103   6
         1  72  86

               Accuracy : 0.7079
                 95% CI : (0.6493, 0.7617)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 0.03974

                  Kappa : 0.4473

 Mcnemar's Test P-Value : 1.842e-13

            Sensitivity : 0.5886
            Specificity : 0.9348
         Pos Pred Value : 0.9450
         Neg Pred Value : 0.5443
             Prevalence : 0.6554
         Detection Rate : 0.3858
   Detection Prevalence : 0.4082
      Balanced Accuracy : 0.7617

       'Positive' Class : 0

[1] "Laplace factor of 0.75"
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0  74   3
         1 101  89

               Accuracy : 0.6105
                 95% CI : (0.5492, 0.6693)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 0.9452

                  Kappa : 0.3115

 Mcnemar's Test P-Value : <2e-16

            Sensitivity : 0.4229
            Specificity : 0.9674
         Pos Pred Value : 0.9610
         Neg Pred Value : 0.4684
             Prevalence : 0.6554
         Detection Rate : 0.2772
   Detection Prevalence : 0.2884
      Balanced Accuracy : 0.6951

       'Positive' Class : 0

[1] "Laplace factor of 1"
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0  40   2
         1 135  90
```

```
               Accuracy : 0.4869
                 95% CI : (0.4255, 0.5486)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 1

                  Kappa : 0.154

 Mcnemar's Test P-Value : <2e-16

            Sensitivity : 0.2286
            Specificity : 0.9783
         Pos Pred Value : 0.9524
         Neg Pred Value : 0.4000
             Prevalence : 0.6554
         Detection Rate : 0.1498
   Detection Prevalence : 0.1573
      Balanced Accuracy : 0.6034

       'Positive' Class : 0

[1] "Laplace factor of 1.25"
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0  23   0
         1 152  92

               Accuracy : 0.4307
                 95% CI : (0.3705, 0.4925)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 1

                  Kappa : 0.0944

 Mcnemar's Test P-Value : <2e-16

            Sensitivity : 0.13143
            Specificity : 1.00000
         Pos Pred Value : 1.00000
         Neg Pred Value : 0.37705
             Prevalence : 0.65543
         Detection Rate : 0.08614
   Detection Prevalence : 0.08614
      Balanced Accuracy : 0.56571

       'Positive' Class : 0

[1] "Laplace factor of 1.5"
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0   8   0
         1 167  92

               Accuracy : 0.3745
                 95% CI : (0.3163, 0.4356)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 1
```

```
                 Kappa : 0.032

 Mcnemar's Test P-Value : <2e-16

            Sensitivity : 0.04571
            Specificity : 1.00000
         Pos Pred Value : 1.00000
         Neg Pred Value : 0.35521
             Prevalence : 0.65543
         Detection Rate : 0.02996
   Detection Prevalence : 0.02996
      Balanced Accuracy : 0.52286

       'Positive' Class : 0

[1] "Laplace factor of 1.75"
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0   1   0
         1 174  92

               Accuracy : 0.3483
                 95% CI : (0.2913, 0.4088)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 1

                 Kappa : 0.0039

 Mcnemar's Test P-Value : <2e-16

            Sensitivity : 0.005714
            Specificity : 1.000000
         Pos Pred Value : 1.000000
         Neg Pred Value : 0.345865
             Prevalence : 0.655431
         Detection Rate : 0.003745
   Detection Prevalence : 0.003745
      Balanced Accuracy : 0.502857

       'Positive' Class : 0

[1] "Laplace factor of 2"
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0   0   0
         1 175  92

               Accuracy : 0.3446
                 95% CI : (0.2877, 0.4049)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 1

                 Kappa : 0

 Mcnemar's Test P-Value : <2e-16
```

```
            Sensitivity : 0.0000
            Specificity : 1.0000
         Pos Pred Value :    NaN
         Neg Pred Value : 0.3446
             Prevalence : 0.6554
         Detection Rate : 0.0000
   Detection Prevalence : 0.0000
      Balanced Accuracy : 0.5000

       'Positive' Class : 0

[1] "Laplace factor of 2.25"
Confusion Matrix and Statistics

          Reference
Prediction   0   1
         0   0   0
         1 175  92

               Accuracy : 0.3446
                 95% CI : (0.2877, 0.4049)
    No Information Rate : 0.6554
    P-Value [Acc > NIR] : 1

                  Kappa : 0

 Mcnemar's Test P-Value : <2e-16

            Sensitivity : 0.0000
            Specificity : 1.0000
         Pos Pred Value :    NaN
         Neg Pred Value : 0.3446
             Prevalence : 0.6554
         Detection Rate : 0.0000
   Detection Prevalence : 0.0000
      Balanced Accuracy : 0.5000

       'Positive' Class : 0
```

El modelo muestra una precision aceptable del 82%. No obstante, al evaluar las predicciones con el archivo original, se evidencian algunas consideraciones. En primer lugar, se encuentran reviews en diferentes idiomas, incluyendo espaniol, mientras que el modelo se entreno exclusivamente en ingles. Es claro que el modelo no podra predecir con precision en estos casos, dado que todas las transformaciones se basaron en la estructura del ingles. En segundo lugar, se observa que la base de datos original contiene errores de etiquetado. Por ejemplo, hay casos en los que comentarios con carga emotiva positiva estan clasificados erroneamente como polaridad = 0, como en el caso de "neat nice, smooth, speed but downloading is lacking in speed correct this I'll give u 5 star". Este comentario incluye adjetivos positivos junto con una critica sobre la velocidad de descarga, lo cual deberia haber sido etiquetado como polaridad = 1. En tercer lugar, al remover emojis de los comentarios, se logró una limpieza adicional del texto y una mejora en la precision del modelo, pasando de aproximadamente un 74% a un 82% final. Por ultimo, se aplico Laplace para ajustar el modelo frente a casos de probabilidad cero entre los datos de entrenamiento y prueba. Sin embargo, no se observo una variacion

significativa en la precision. Esto podria deberse a que el vocabulario del texto es limitado, lo que resulta en pocas palabras presentes en el conjunto de prueba pero ausentes en el conjunto de entrenamiento.