Linear Classification

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23/02/2020

### Operaciones abajo son para el pre-processing de los datos:

Para el pre-processing de los datos en la Musk.data, hemos realizado los siguientes procedimientos: -Asignamos nombres a las columnas, tal cual estaba denifido en Musk2.info -Pasar el atributo “class” a factor y cambiar las labels de 0 a “No” (para No Musk) y de 1 a “Yes” para el caso de Musk -Quitar un total de 17 filas duplicadas -Hemos estandarizado los valores numericos, pues no estabamos seguros de que todos teniam la misma unidad -Aplicamos la función de PCA, y nos fijamos que no hay “codos” que nos digan con certitumbre cuantos componentes significativas hay. Se nota que hay un pequeño codo convexo a un valor aproximado a 15 pero no se podría decir con toda certeza que esta seria la cantidad de componentes significativos. Por lo tanto, definimos el numero de componentes significativas igual a 25 pues acumula 90,08% de dimensiones significativas.

Obs.: No obstante, aunque la analisis de PCA ha ayudado a identificar el numero de dimensiones significativas, pero nos estaba ocasionando errores que no fuimos capaces de solucionar. Por otro lado, como bien intenta expresar los resultados finales, suponemos haber conseguido llegar a conclusiones interesantes con los algoritmos.

library(dplyr)

##   
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':  
##   
## filter, lag

## The following objects are masked from 'package:base':  
##   
## intersect, setdiff, setequal, union

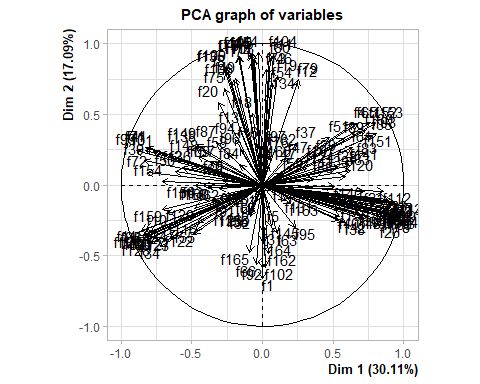
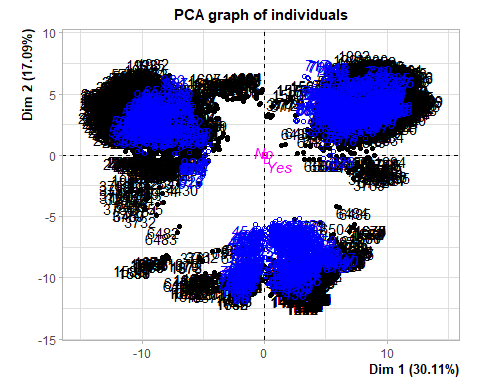
library(tidyr)  
#library(outliers)  
setwd("C:/Users/Daniel/Documents/Certificados & Faculdade/UPC Master Big Data/Data Analytics/Mathematical Foundations/Clase4/Musk")  
  
Musk <- read.table(file.choose(),sep = ",") %>% select(-c(V1,V2))  
  
#Leer el fichero Musk y quitar los atributos molecule\_name y conformation\_name  
Musk <- read.table("Musk2.data", sep = ",") %>% select(-c(V1,V2))  
head(Musk,5)

## V3 V4 V5 V6 V7 V8 V9 V10 V11 V12 V13 V14 V15 V16 V17 V18  
## 1 46 -108 -60 -69 -117 49 38 -161 -8 5 -323 -220 -113 -299 -283 -307  
## 2 41 -188 -145 22 -117 -6 57 -171 -39 -100 -319 -111 -228 -281 -281 -300  
## 3 46 -194 -145 28 -117 73 57 -168 -39 -22 -319 -111 -104 -283 -282 -303  
## 4 41 -188 -145 22 -117 -7 57 -170 -39 -99 -319 -111 -228 -282 -281 -301  
## 5 41 -188 -145 22 -117 -7 57 -170 -39 -99 -319 -111 -228 -282 -281 -301  
## V19 V20 V21 V22 V23 V24 V25 V26 V27 V28 V29 V30 V31 V32 V33 V34 V35  
## 1 -31 -106 -227 -42 -59 -22 -67 189 81 17 -27 -89 -67 105 -116 124 -106  
## 2 54 -149 -98 -196 -27 -22 2 75 49 -34 45 -91 32 95 -116 85 -23  
## 3 52 -152 -97 -225 -28 -22 2 179 49 -33 46 -88 22 79 -116 19 -11  
## 4 54 -150 -98 -196 -28 -22 2 77 48 -34 46 -91 32 94 -116 84 -23  
## 5 54 -150 -98 -196 -28 -22 2 78 48 -34 46 -91 31 94 -116 84 -23  
## V36 V37 V38 V39 V40 V41 V42 V43 V44 V45 V46 V47 V48 V49 V50  
## 1 5 -120 63 -165 40 -27 68 -44 98 -33 -314 -282 -335 -144 -13  
## 2 42 -58 61 -171 2 -144 38 -153 113 -166 -318 -241 -329 -97 -69  
## 3 6 -38 71 -175 3 -129 37 -172 93 -42 -317 -242 -331 -98 -71  
## 4 41 -58 62 -171 3 -144 38 -153 113 -163 -319 -242 -329 -97 -69  
## 5 41 -58 62 -171 3 -144 38 -153 113 -163 -319 -242 -329 -97 -69  
## V51 V52 V53 V54 V55 V56 V57 V58 V59 V60 V61 V62 V63 V64 V65 V66  
## 1 -197 -2 -144 -13 -11 -131 108 -43 42 -151 -4 8 -102 51 -15 108  
## 2 -108 -179 -71 -27 -12 -133 107 -96 92 -140 48 26 -62 2 13 58  
## 3 -106 -128 -71 -26 -12 -131 147 -93 93 -139 40 51 -28 -179 34 30  
## 4 -108 -180 -71 -26 -12 -133 107 -95 93 -140 47 27 -63 -1 12 57  
## 5 -108 -180 -71 -26 -12 -133 107 -95 93 -140 47 27 -63 -1 12 57  
## V67 V68 V69 V70 V71 V72 V73 V74 V75 V76 V77 V78 V79 V80 V81  
## 1 -135 59 -166 20 -20 23 -48 -68 -299 -256 -97 -183 -24 -271 -229  
## 2 -12 59 -166 -85 -131 -57 -156 -121 -285 -189 -255 -181 2 -284 -103  
## 3 -21 56 -166 -85 -67 -57 -157 -133 -263 -190 -231 -182 1 -286 -103  
## 4 -12 59 -166 -84 -131 -56 -156 -122 -286 -191 -255 -181 1 -284 -104  
## 5 -12 59 -166 -84 -131 -56 -156 -122 -286 -191 -255 -181 1 -284 -104  
## V82 V83 V84 V85 V86 V87 V88 V89 V90 V91 V92 V93 V94 V95 V96 V97  
## 1 -177 -6 0 -129 112 15 36 -66 -54 -75 132 -188 119 -120 -312 23  
## 2 -186 -18 15 -31 127 -5 24 -82 -168 10 79 -200 82 14 -101 28  
## 3 -184 -19 14 -31 55 19 24 -88 -165 14 68 -202 47 -10 -85 19  
## 4 -185 -19 14 -31 128 -5 24 -82 -168 9 78 -200 82 13 -101 28  
## 5 -185 -19 14 -31 128 -5 24 -82 -168 9 78 -200 82 13 -101 28  
## V98 V99 V100 V101 V102 V103 V104 V105 V106 V107 V108 V109 V110 V111 V112  
## 1 -55 -53 -26 -71 41 -55 148 -247 -306 -308 -230 -166 -35 -205 -280  
## 2 -52 -43 31 -156 79 -158 137 -281 -305 -294 -262 -165 -117 -244 -246  
## 3 40 -10 32 -156 79 -193 122 -271 -305 -296 -265 -168 -119 -244 -247  
## 4 -50 -44 31 -156 80 -158 137 -282 -306 -295 -263 -166 -118 -244 -247  
## 5 -50 -44 31 -156 80 -158 137 -282 -306 -295 -263 -166 -118 -244 -247  
## V113 V114 V115 V116 V117 V118 V119 V120 V121 V122 V123 V124 V125 V126  
## 1 -239 -53 -10 -23 25 -5 163 61 59 -39 92 72 113 -107  
## 2 -231 3 -2 -3 15 49 99 37 84 22 66 131 109 -77  
## 3 -230 3 -2 -3 -23 12 128 38 85 24 61 122 74 -36  
## 4 -231 3 -2 -3 14 50 99 37 84 23 66 131 109 -78  
## 5 -231 3 -2 -3 14 50 99 37 84 23 66 131 109 -78  
## V127 V128 V129 V130 V131 V132 V133 V134 V135 V136 V137 V138 V139 V140  
## 1 80 25 -27 81 -114 -187 45 -118 -75 -182 -234 -19 12 -13  
## 2 -10 -17 17 88 -21 -32 32 -128 -72 -124 -218 -94 53 -79  
## 3 -129 19 41 64 0 -23 -15 -129 -74 -125 -221 -93 53 -72  
## 4 -12 -18 17 88 -20 -32 32 -128 -73 -125 -220 -93 53 -78  
## 5 -12 -18 17 88 -20 -32 32 -128 -73 -125 -220 -93 53 -78  
## V141 V142 V143 V144 V145 V146 V147 V148 V149 V150 V151 V152 V153 V154  
## 1 -41 -119 -149 70 17 -20 -177 -101 -116 -14 -50 24 -81 -125  
## 2 -20 -35 -26 4 50 17 -177 -102 -121 -66 -77 51 -41 -34  
## 3 -19 -33 -26 3 49 17 -177 -102 -119 -66 -81 51 -41 -27  
## 4 -19 -34 -26 4 50 17 -177 -101 -121 -65 -77 52 -41 -34  
## 5 -19 -34 -26 4 50 17 -177 -101 -121 -65 -76 52 -41 -34  
## V155 V156 V157 V158 V159 V160 V161 V162 V163 V164 V165 V166 V167 V168  
## 1 -114 -44 128 3 -244 -308 52 -7 39 126 156 -50 -112 96  
## 2 -32 -63 115 -5 -235 -59 -2 52 103 136 169 -61 -136 79  
## 3 -41 -140 77 -163 -238 -134 -154 57 143 142 165 -67 -145 39  
## 4 -32 -66 115 -7 -236 -60 -4 52 104 136 168 -60 -135 80  
## 5 -32 -66 115 -8 -236 -60 -4 52 104 137 168 -60 -135 80  
## V169  
## 1 1  
## 2 1  
## 3 1  
## 4 1  
## 5 1

#Asignar los nombres a las columnas  
colnames(Musk) <- c('f1','f2','f3','f4','f5','f6','f7','f8','f9','f10','f11','f12','f13','f14','f15','f16','f17','f18','f19','f20','f21','f22','f23','f24','f25','f26','f27','f28','f29','f30','f31','f32','f33','f34','f35','f36','f37','f38','f39','f40','f41','f42','f43','f44','f45','f46','f47','f48','f49','f50','f51','f52','f53','f54','f55','f56','f57','f58','f59','f60','f61','f62','f63','f64','f65','f66','f67','f68','f69','f70','f71','f72','f73','f74','f75','f76','f77','f78','f79','f80','f81','f82','f83','f84','f85','f86','f87','f88','f89','f90','f91','f92','f93','f94','f95','f96','f97','f98','f99','f100','f101','f102','f103','f104','f105','f106','f107','f108','f109','f110','f111','f112','f113','f114','f115','f116','f117','f118','f119','f120','f121','f122','f123','f124','f125','f126','f127','f128','f129','f130','f131','f132','f133','f134','f135','f136','f137','f138','f139','f140','f141','f142','f143','f144','f145','f146','f147','f148','f149','f150','f151','f152','f153','f154','f155','f156','f157','f158','f159','f160','f161','f162','f163','f164','f165','f166', 'class')  
  
Musk$class <- factor(Musk$class, labels=c("No", "Yes"))  
  
Musk <- Musk[!duplicated(Musk),]  
  
funumeric <- function(value){  
 if(is.numeric(value)){  
 as.vector(scale(value))  
 } else  
 {  
 value  
 }  
}  
Musk <- data.frame(lapply(Musk,funumeric))  
summary(Musk)

## f1 f2 f3 f4   
## Min. :-1.6978 Min. :-0.8809 Min. :-1.3829 Min. :-1.4110   
## 1st Qu.:-0.4113 1st Qu.:-0.8148 1st Qu.:-0.9415 1st Qu.:-0.8642   
## Median :-0.2788 Median :-0.3302 Median :-0.3678 Median :-0.3050   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.:-0.1086 3rd Qu.: 0.2646 3rd Qu.: 0.7945 3rd Qu.: 0.5275   
## Max. : 4.4132 Max. : 2.3573 Max. : 2.2656 Max. : 2.0063   
## f5 f6 f7 f8   
## Min. :-0.2221 Min. :-2.4950 Min. :-1.3579 Min. :-2.4798   
## 1st Qu.:-0.2063 1st Qu.:-0.5739 1st Qu.:-1.2539 1st Qu.:-0.9045   
## Median :-0.2063 Median : 0.1822 Median : 0.3576 Median : 0.2270   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.:-0.1905 3rd Qu.: 0.6903 3rd Qu.: 0.6175 3rd Qu.: 0.6930   
## Max. : 6.7707 Max. : 2.2520 Max. : 2.0298 Max. : 3.5662   
## f9 f10 f11 f12   
## Min. :-1.4651 Min. :-3.3460 Min. :-1.9239 Min. :-2.968441   
## 1st Qu.:-1.2069 1st Qu.:-0.7262 1st Qu.:-0.7918 1st Qu.:-0.367012   
## Median : 0.4254 Median : 0.2164 Median : 0.3312 Median :-0.002561   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.000000   
## 3rd Qu.: 0.6007 3rd Qu.: 0.6599 3rd Qu.: 0.6718 3rd Qu.: 0.625804   
## Max. : 2.1500 Max. : 3.8203 Max. : 2.7152 Max. : 3.378040   
## f13 f14 f15 f16   
## Min. :-3.95410 Min. :-2.1227 Min. :-1.7510 Min. :-0.8683   
## 1st Qu.:-0.36047 1st Qu.:-0.7073 1st Qu.:-0.7190 1st Qu.:-0.5006   
## Median :-0.06778 Median : 0.3518 Median : 0.3437 Median :-0.3450   
## Mean : 0.00000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.27370 3rd Qu.: 0.5498 3rd Qu.: 0.5072 3rd Qu.:-0.1046   
## Max. : 4.17629 Max. : 2.8264 Max. : 3.0107 Max. : 4.8872   
## f17 f18 f19   
## Min. :-1.452567 Min. :-3.9173 Min. :-2.8339   
## 1st Qu.:-1.051857 1st Qu.:-0.2839 1st Qu.:-0.5554   
## Median : 0.005334 Median :-0.0232 Median : 0.1597   
## Mean : 0.000000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.909061 3rd Qu.: 0.3515 3rd Qu.: 0.5717   
## Max. : 1.633749 Max. : 4.1805 Max. : 3.3592   
## f20 f21 f22 f23   
## Min. :-2.61243 Min. :-2.9135 Min. :-1.2656 Min. :-2.0215   
## 1st Qu.:-0.19172 1st Qu.:-0.5614 1st Qu.:-1.2166 1st Qu.:-0.9856   
## Median : 0.08566 Median : 0.1694 Median : 0.3614 Median : 0.2194   
## Mean : 0.00000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.42607 3rd Qu.: 0.5016 3rd Qu.: 0.4595 3rd Qu.: 0.7374   
## Max. : 3.42675 Max. : 3.5845 Max. : 2.4100 Max. : 2.9043   
## f24 f25 f26 f27   
## Min. :-1.2016 Min. :-1.2212 Min. :-1.6981 Min. :-2.0668   
## 1st Qu.:-1.0801 1st Qu.:-1.1750 1st Qu.:-1.1065 1st Qu.:-0.9762   
## Median : 0.1841 Median : 0.4423 Median : 0.3430 Median : 0.4196   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.9135 3rd Qu.: 0.7104 3rd Qu.: 0.7867 3rd Qu.: 0.6923   
## Max. : 1.9832 Max. : 2.2630 Max. : 2.4925 Max. : 1.9573   
## f28 f29 f30 f31   
## Min. :-0.8572 Min. :-2.372790 Min. :-1.3817 Min. :-0.4326   
## 1st Qu.:-0.6947 1st Qu.:-0.813423 1st Qu.:-1.1677 1st Qu.:-0.4201   
## Median :-0.3969 Median : 0.005639 Median : 0.4411 Median :-0.4201   
## Mean : 0.0000 Mean : 0.000000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.2394 3rd Qu.: 0.383667 3rd Qu.: 0.7264 3rd Qu.:-0.3205   
## Max. : 3.3531 Max. : 2.604584 Max. : 2.0103 Max. : 4.8735   
## f32 f33 f34 f35   
## Min. :-1.5796 Min. :-1.8082 Min. :-1.6898 Min. :-1.1539   
## 1st Qu.:-1.0918 1st Qu.:-0.8045 1st Qu.:-1.1149 1st Qu.:-0.8354   
## Median :-0.1349 Median : 0.1820 Median : 0.3817 Median :-0.6231   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.9908 3rd Qu.: 0.4243 3rd Qu.: 0.7875 3rd Qu.: 0.6773   
## Max. : 2.6701 Max. : 4.1797 Max. : 2.0219 Max. : 3.8886   
## f36 f37 f38 f39   
## Min. :-2.1578 Min. :-0.5685 Min. :-2.1216 Min. :-1.0268   
## 1st Qu.:-0.6630 1st Qu.:-0.5589 1st Qu.:-0.8748 1st Qu.:-0.9701   
## Median :-0.2410 Median :-0.4921 Median : 0.1623 Median :-0.4034   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.6207 3rd Qu.:-0.2345 3rd Qu.: 0.7565 3rd Qu.: 0.7158   
## Max. : 3.6629 Max. : 2.5045 Max. : 2.2714 Max. : 2.5858   
## f40 f41 f42 f43   
## Min. :-2.3829 Min. :-1.1115 Min. :-1.9046 Min. :-4.12969   
## 1st Qu.:-0.6509 1st Qu.:-0.8988 1st Qu.:-0.5249 1st Qu.:-0.32029   
## Median : 0.3140 Median :-0.3196 Median : 0.0335 Median : 0.01096   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.00000   
## 3rd Qu.: 0.7099 3rd Qu.: 0.5668 3rd Qu.: 0.5919 3rd Qu.: 0.29253   
## Max. : 2.2439 Max. : 2.1743 Max. : 3.7563 Max. : 4.48287   
## f44 f45 f46 f47   
## Min. :-1.9876 Min. :-2.0558 Min. :-1.6911 Min. :-0.94631   
## 1st Qu.:-0.6350 1st Qu.:-0.7985 1st Qu.:-0.9254 1st Qu.:-0.81147   
## Median : 0.4221 Median : 0.3365 Median : 0.2977 Median :-0.27214   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.00000   
## 3rd Qu.: 0.5743 3rd Qu.: 0.5145 3rd Qu.: 0.6358 3rd Qu.: 0.08741   
## Max. : 2.8586 Max. : 3.0291 Max. : 3.2908 Max. : 3.08370   
## f48 f49 f50 f51   
## Min. :-2.4566 Min. :-2.9556 Min. :-3.2918 Min. :-3.54083   
## 1st Qu.:-0.5771 1st Qu.:-0.8585 1st Qu.:-0.7016 1st Qu.:-0.65981   
## Median : 0.1989 Median : 0.1471 Median :-0.1162 Median : 0.04913   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.00000   
## 3rd Qu.: 0.5990 3rd Qu.: 0.6254 3rd Qu.: 0.5131 3rd Qu.: 0.32064   
## Max. : 3.2303 Max. : 3.6423 Max. : 3.9374 Max. : 3.97093   
## f52 f53 f54 f55   
## Min. :-1.3318 Min. :-1.4397 Min. :-1.6506 Min. :-2.2774   
## 1st Qu.:-1.2354 1st Qu.:-1.2288 1st Qu.:-0.8384 1st Qu.:-1.0200   
## Median : 0.4042 Median : 0.4291 Median : 0.2088 Median : 0.3204   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.5295 3rd Qu.: 0.5824 3rd Qu.: 0.5934 3rd Qu.: 0.7830   
## Max. : 2.3620 Max. : 2.1541 Max. : 3.4999 Max. : 2.2420   
## f56 f57 f58 f59   
## Min. :-3.20970 Min. :-1.5522 Min. :-0.8230 Min. :-3.2137   
## 1st Qu.:-0.50863 1st Qu.:-1.2505 1st Qu.:-0.7226 1st Qu.:-0.6076   
## Median : 0.05533 Median : 0.3113 Median :-0.3839 Median :-0.1058   
## Mean : 0.00000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.44120 3rd Qu.: 0.7816 3rd Qu.: 0.1555 3rd Qu.: 0.6064   
## Max. : 4.10694 Max. : 1.9884 Max. : 2.8272 Max. : 2.8078   
## f60 f61 f62 f63   
## Min. :-2.0977 Min. :-0.8069 Min. :-1.1801 Min. :-2.10654   
## 1st Qu.:-1.0070 1st Qu.:-0.7862 1st Qu.:-1.0631 1st Qu.:-0.75711   
## Median : 0.4473 Median :-0.4870 Median :-0.1103 Median : 0.03179   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.00000   
## 3rd Qu.: 0.7126 3rd Qu.: 0.3694 3rd Qu.: 0.9846 3rd Qu.: 0.48852   
## Max. : 2.3241 Max. : 2.8665 Max. : 1.9625 Max. : 5.86550   
## f64 f65 f66 f67   
## Min. :-1.3509 Min. :-1.2197 Min. :-1.58814 Min. :-0.2343   
## 1st Qu.:-1.1987 1st Qu.:-0.8674 1st Qu.:-0.39826 1st Qu.:-0.2135   
## Median : 0.1105 Median :-0.4329 Median :-0.36221 Median :-0.2135   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.00000 Mean : 0.0000   
## 3rd Qu.: 0.9630 3rd Qu.: 0.5887 3rd Qu.: 0.03442 3rd Qu.:-0.1928   
## Max. : 1.8459 Max. : 2.0331 Max. : 4.25305 Max. : 8.0947   
## f68 f69 f70 f71   
## Min. :-2.9803 Min. :-1.21238 Min. :-3.12485 Min. :-1.1662   
## 1st Qu.:-0.6050 1st Qu.:-1.19233 1st Qu.:-0.67316 1st Qu.:-0.8795   
## Median :-0.2035 Median : 0.05092 Median :-0.06447 Median :-0.4364   
## Mean : 0.0000 Mean : 0.00000 Mean : 0.00000 Mean : 0.0000   
## 3rd Qu.: 0.5660 3rd Qu.: 0.86305 3rd Qu.: 0.40896 3rd Qu.: 0.6452   
## Max. : 2.7740 Max. : 2.45722 Max. : 2.77611 Max. : 2.2220   
## f72 f73 f74 f75   
## Min. :-1.0219 Min. :-2.4375 Min. :-2.6275 Min. :-2.4354   
## 1st Qu.:-0.9483 1st Qu.:-0.6487 1st Qu.:-0.8102 1st Qu.:-0.2867   
## Median :-0.3738 Median : 0.2511 Median : 0.2595 Median : 0.1358   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.6869 3rd Qu.: 0.5764 3rd Qu.: 0.5471 3rd Qu.: 0.4858   
## Max. : 2.6755 Max. : 3.0373 Max. : 3.1811 Max. : 3.3225   
## f76 f77 f78 f79   
## Min. :-1.37125 Min. :-1.4522 Min. :-2.1244 Min. :-2.80350   
## 1st Qu.:-0.44207 1st Qu.:-1.2534 1st Qu.:-0.8439 1st Qu.:-0.38120   
## Median :-0.29912 Median : 0.4368 Median : 0.3886 Median :-0.04377   
## Mean : 0.00000 Mean : 0.0000 Mean : 0.0000 Mean : 0.00000   
## 3rd Qu.:-0.01322 3rd Qu.: 0.7103 3rd Qu.: 0.6389 3rd Qu.: 0.71546   
## Max. :14.06744 Max. : 1.9862 Max. : 3.1520 Max. : 3.21007   
## f80 f81 f82 f83   
## Min. :-1.8579 Min. :-1.9606 Min. :-1.3045 Min. :-3.1542   
## 1st Qu.:-0.6063 1st Qu.:-0.9499 1st Qu.:-1.2301 1st Qu.:-0.5937   
## Median : 0.3651 Median : 0.3692 Median : 0.4236 Median : 0.1098   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.6173 3rd Qu.: 0.6246 3rd Qu.: 0.5629 3rd Qu.: 0.4334   
## Max. : 2.9150 Max. : 2.8587 Max. : 2.1888 Max. : 3.5144   
## f84 f85 f86 f87   
## Min. :-1.7128 Min. :-1.6886 Min. :-1.4023 Min. :-1.7025   
## 1st Qu.:-1.0620 1st Qu.:-1.1112 1st Qu.:-1.2546 1st Qu.:-0.5715   
## Median : 0.3327 Median : 0.4286 Median : 0.5008 Median :-0.1591   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.6839 3rd Qu.: 0.7269 3rd Qu.: 0.6137 3rd Qu.: 0.3711   
## Max. : 2.1199 Max. : 2.2859 Max. : 2.0475 Max. : 2.0205   
## f88 f89 f90 f91   
## Min. :-1.4301 Min. :-1.75200 Min. :-1.5106 Min. :-0.8129   
## 1st Qu.:-0.8456 1st Qu.:-0.93176 1st Qu.:-1.1881 1st Qu.:-0.8129   
## Median :-0.2993 Median :-0.06509 Median : 0.4083 Median :-0.7228   
## Mean : 0.0000 Mean : 0.00000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.6282 3rd Qu.: 0.52300 3rd Qu.: 0.8356 3rd Qu.: 0.9711   
## Max. : 3.4614 Max. : 2.31824 Max. : 1.9240 Max. : 3.1245   
## f92 f93 f94 f95   
## Min. :-1.4921 Min. :-1.0228 Min. :-2.4729 Min. :-2.6126   
## 1st Qu.:-0.8115 1st Qu.:-0.9029 1st Qu.:-0.2519 1st Qu.:-0.5290   
## Median :-0.3380 Median :-0.6750 Median : 0.1025 Median :-0.1817   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.6829 3rd Qu.: 0.6799 3rd Qu.: 0.4214 3rd Qu.: 0.3507   
## Max. : 3.2723 Max. : 3.1500 Max. : 3.5757 Max. : 5.6522   
## f96 f97 f98 f99   
## Min. :-1.33158 Min. :-1.41815 Min. :-1.4311 Min. :-1.0039   
## 1st Qu.:-1.14692 1st Qu.:-1.06630 1st Qu.:-1.2768 1st Qu.:-0.9417   
## Median : 0.03134 Median : 0.01942 Median : 0.5108 Median :-0.5527   
## Mean : 0.00000 Mean : 0.00000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.95461 3rd Qu.: 0.57233 3rd Qu.: 0.6469 3rd Qu.: 1.0655   
## Max. : 2.32632 Max. : 2.16069 Max. : 2.1351 Max. : 2.0612   
## f100 f101 f102 f103   
## Min. :-1.5892 Min. :-1.1250 Min. :-1.9498 Min. :-2.0316   
## 1st Qu.:-1.3069 1st Qu.:-0.9390 1st Qu.:-0.7361 1st Qu.:-0.6598   
## Median : 0.5001 Median :-0.1622 Median :-0.2043 Median : 0.2685   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.6413 3rd Qu.: 0.5272 3rd Qu.: 0.3957 3rd Qu.: 0.5882   
## Max. : 2.1095 Max. : 2.1575 Max. : 3.2457 Max. : 2.8368   
## f104 f105 f106 f107   
## Min. :-1.8720 Min. :-1.8146 Min. :-2.0148 Min. :-0.95140   
## 1st Qu.:-0.5878 1st Qu.:-0.6010 1st Qu.:-0.7684 1st Qu.:-0.57945   
## Median : 0.3661 Median : 0.3660 Median : 0.1775 Median :-0.42208   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.00000   
## 3rd Qu.: 0.6138 3rd Qu.: 0.4844 3rd Qu.: 0.6449 3rd Qu.: 0.05002   
## Max. : 2.8519 Max. : 2.8526 Max. : 3.5049 Max. : 4.18449   
## f108 f109 f110 f111   
## Min. :-2.1174 Min. :-1.7414 Min. :-1.8793 Min. :-1.7500   
## 1st Qu.:-0.8112 1st Qu.:-0.8331 1st Qu.:-0.7829 1st Qu.:-0.7263   
## Median : 0.1945 Median : 0.1874 Median : 0.3368 Median : 0.3290   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.7840 3rd Qu.: 0.7385 3rd Qu.: 0.4651 3rd Qu.: 0.4768   
## Max. : 3.1884 Max. : 2.8407 Max. : 3.1594 Max. : 3.0940   
## f112 f113 f114 f115   
## Min. :-2.33900 Min. :-1.5773 Min. :-1.427 Min. :-2.1295   
## 1st Qu.:-0.81293 1st Qu.:-1.2088 1st Qu.:-1.252 1st Qu.:-1.0508   
## Median : 0.08677 Median : 0.3335 Median : 0.330 Median : 0.4045   
## Mean : 0.00000 Mean : 0.0000 Mean : 0.000 Mean : 0.0000   
## 3rd Qu.: 0.71315 3rd Qu.: 0.7893 3rd Qu.: 0.728 3rd Qu.: 0.7810   
## Max. : 3.12753 Max. : 2.4770 Max. : 2.301 Max. : 2.6128   
## f116 f117 f118 f119   
## Min. :-3.73291 Min. :-1.3162 Min. :-1.5296 Min. :-1.4796   
## 1st Qu.:-0.58198 1st Qu.:-1.2043 1st Qu.:-1.2046 1st Qu.:-1.2472   
## Median :-0.02417 Median : 0.4018 Median : 0.4925 Median : 0.2135   
## Mean : 0.00000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.47335 3rd Qu.: 0.8013 3rd Qu.: 0.7272 3rd Qu.: 0.8442   
## Max. : 3.95594 Max. : 2.0238 Max. : 1.7924 Max. : 1.8816   
## f120 f121 f122 f123   
## Min. :-1.4899 Min. :-1.2489 Min. :-2.0903 Min. :-1.8318   
## 1st Qu.:-1.0585 1st Qu.:-1.1700 1st Qu.:-1.0462 1st Qu.:-1.2480   
## Median : 0.3561 Median : 0.5209 Median : 0.1255 Median : 0.4834   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.7674 3rd Qu.: 0.6261 3rd Qu.: 0.8215 3rd Qu.: 0.7308   
## Max. : 2.0515 Max. : 2.1506 Max. : 2.2600 Max. : 2.1753   
## f124 f125 f126 f127   
## Min. :-1.8182 Min. :-1.2673 Min. :-2.53481 Min. :-2.7782   
## 1st Qu.:-0.8971 1st Qu.:-1.1259 1st Qu.:-0.53454 1st Qu.:-0.7813   
## Median : 0.3406 Median : 0.1470 Median : 0.07607 Median : 0.2287   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.00000 Mean : 0.0000   
## 3rd Qu.: 0.7435 3rd Qu.: 0.9426 3rd Qu.: 0.28662 3rd Qu.: 0.6118   
## Max. : 3.2766 Max. : 2.6486 Max. : 5.40310 Max. : 3.0847   
## f128 f129 f130 f131   
## Min. :-1.5402 Min. :-3.41067 Min. :-0.9604 Min. :-2.0860   
## 1st Qu.:-1.1499 1st Qu.:-0.62709 1st Qu.:-0.9401 1st Qu.:-0.7619   
## Median : 0.5641 Median :-0.02755 Median :-0.3592 Median : 0.2643   
## Mean : 0.0000 Mean : 0.00000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.7707 3rd Qu.: 0.54344 3rd Qu.: 0.7108 3rd Qu.: 0.5623   
## Max. : 1.9949 Max. : 3.91228 Max. : 2.2089 Max. : 4.6008   
## f132 f133 f134 f135   
## Min. :-1.2272 Min. :-3.87933 Min. :-3.62953 Min. :-2.7590   
## 1st Qu.:-0.9307 1st Qu.:-0.23922 1st Qu.:-0.51852 1st Qu.:-0.8542   
## Median :-0.2428 Median : 0.01963 Median : 0.05378 Median : 0.1785   
## Mean : 0.0000 Mean : 0.00000 Mean : 0.00000 Mean : 0.0000   
## 3rd Qu.: 0.6704 3rd Qu.: 0.24613 3rd Qu.: 0.43532 3rd Qu.: 0.6719   
## Max. : 3.4574 Max. : 4.12891 Max. : 3.81047 Max. : 3.6094   
## f136 f137 f138 f139   
## Min. :-2.72127 Min. :-1.9202 Min. :-2.0794 Min. :-1.8461   
## 1st Qu.:-0.90555 1st Qu.:-1.0535 1st Qu.:-0.6629 1st Qu.:-1.0131   
## Median : 0.03474 Median : 0.4861 Median :-0.1221 Median : 0.3472   
## Mean : 0.00000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.29413 3rd Qu.: 0.6289 3rd Qu.: 0.2900 3rd Qu.: 0.6846   
## Max. : 2.48273 Max. : 1.9850 Max. : 2.1572 Max. : 2.8461   
## f140 f141 f142 f143   
## Min. :-3.58545 Min. :-3.24250 Min. :-2.2365 Min. :-1.5234   
## 1st Qu.:-0.29463 1st Qu.:-0.50969 1st Qu.:-1.0122 1st Qu.:-1.3019   
## Median : 0.06239 Median : 0.02531 Median : 0.1515 Median : 0.3834   
## Mean : 0.00000 Mean : 0.00000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.29523 3rd Qu.: 0.43017 3rd Qu.: 0.8182 3rd Qu.: 0.7397   
## Max. : 3.95860 Max. : 3.66906 Max. : 2.2365 Max. : 2.2901   
## f144 f145 f146 f147   
## Min. :-1.4448 Min. :-0.2446 Min. :-0.3645 Min. :-1.06595   
## 1st Qu.:-1.2995 1st Qu.:-0.2261 1st Qu.:-0.3059 1st Qu.:-0.36787   
## Median : 0.3767 Median :-0.2261 Median :-0.3059 Median :-0.27480   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.00000   
## 3rd Qu.: 0.7933 3rd Qu.:-0.2261 3rd Qu.:-0.2669 3rd Qu.:-0.08864   
## Max. : 2.2272 Max. : 7.0207 Max. : 6.7982 Max. :13.26789   
## f148 f149 f150 f151   
## Min. :-2.8775 Min. :-2.3226 Min. :-2.3832 Min. :-1.4139   
## 1st Qu.:-0.6430 1st Qu.:-0.6724 1st Qu.:-0.6676 1st Qu.:-0.7655   
## Median :-0.1992 Median :-0.1449 Median : 0.3641 Median :-0.1338   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.5298 3rd Qu.: 0.3285 3rd Qu.: 0.5800 3rd Qu.: 0.4980   
## Max. : 2.3523 Max. : 2.1410 Max. : 2.1156 Max. : 4.9701   
## f152 f153 f154 f155   
## Min. :-0.9471 Min. :-0.8783 Min. :-1.2509 Min. :-1.7911   
## 1st Qu.:-0.8764 1st Qu.:-0.8487 1st Qu.:-1.1597 1st Qu.:-0.7735   
## Median :-0.7211 Median :-0.8339 Median : 0.2082 Median :-0.2850   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.8748 3rd Qu.: 0.9275 3rd Qu.: 0.4688 3rd Qu.: 0.9055   
## Max. : 3.0215 Max. : 3.9321 Max. : 2.5664 Max. : 3.5207   
## f156 f157 f158 f159   
## Min. :-1.4021 Min. :-0.5500 Min. :-1.3296 Min. :-1.1182   
## 1st Qu.:-1.2482 1st Qu.:-0.3472 1st Qu.:-0.8101 1st Qu.:-1.0087   
## Median : 0.3006 Median :-0.2994 Median :-0.4483 Median :-0.4301   
## Mean : 0.0000 Mean : 0.0000 Mean : 0.0000 Mean : 0.0000   
## 3rd Qu.: 0.8238 3rd Qu.:-0.2398 3rd Qu.: 0.9709 3rd Qu.: 1.0008   
## Max. : 2.1983 Max. : 4.2467 Max. : 2.5849 Max. : 1.9939   
## f160 f161 f162 f163   
## Min. :-1.58381 Min. :-1.8313 Min. :-2.49028 Min. :-2.1631   
## 1st Qu.:-0.63095 1st Qu.:-0.8192 1st Qu.:-0.57489 1st Qu.:-0.6018   
## Median : 0.07648 Median :-0.0354 Median :-0.06504 Median :-0.1821   
## Mean : 0.00000 Mean : 0.0000 Mean : 0.00000 Mean : 0.0000   
## 3rd Qu.: 0.50960 3rd Qu.: 0.8377 3rd Qu.: 0.23811 3rd Qu.: 0.2208   
## Max. : 3.15163 Max. : 3.4373 Max. : 3.35234 Max. : 7.1039   
## f164 f165 f166 class   
## Min. :-4.38143 Min. :-3.661194 Min. :-5.4513 No :5564   
## 1st Qu.:-0.37196 1st Qu.:-0.376203 1st Qu.:-0.5405 Yes:1017   
## Median :-0.22682 Median : 0.006387 Median :-0.1578   
## Mean : 0.00000 Mean : 0.000000 Mean : 0.0000   
## 3rd Qu.: 0.04531 3rd Qu.: 0.402169 3rd Qu.: 0.8201   
## Max. : 6.21373 Max. : 4.201678 Max. : 3.4562

library(FactoMineR)  
pca.musk <- PCA(Musk,ind.sup = c(1:1017),quali.sup = 167)



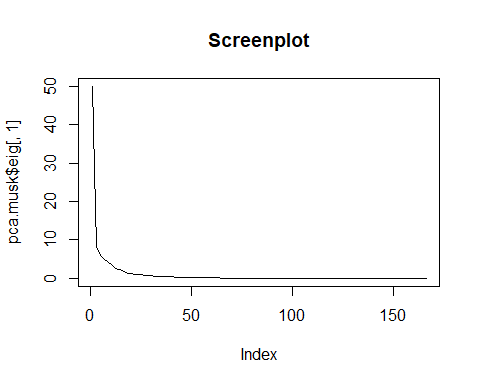
pca.musk

## \*\*Results for the Principal Component Analysis (PCA)\*\*  
## The analysis was performed on 6581 individuals, described by 167 variables  
## \*The results are available in the following objects:  
##   
## name   
## 1 "$eig"   
## 2 "$var"   
## 3 "$var$coord"   
## 4 "$var$cor"   
## 5 "$var$cos2"   
## 6 "$var$contrib"   
## 7 "$ind"   
## 8 "$ind$coord"   
## 9 "$ind$cos2"   
## 10 "$ind$contrib"   
## 11 "$ind.sup"   
## 12 "$ind.sup$coord"   
## 13 "$ind.sup$cos2"   
## 14 "$quali.sup"   
## 15 "$quali.sup$coord"   
## 16 "$quali.sup$v.test"  
## 17 "$call"   
## 18 "$call$centre"   
## 19 "$call$ecart.type"   
## 20 "$call$row.w"   
## 21 "$call$col.w"   
## description   
## 1 "eigenvalues"   
## 2 "results for the variables"   
## 3 "coord. for the variables"   
## 4 "correlations variables - dimensions"   
## 5 "cos2 for the variables"   
## 6 "contributions of the variables"   
## 7 "results for the individuals"   
## 8 "coord. for the individuals"   
## 9 "cos2 for the individuals"   
## 10 "contributions of the individuals"   
## 11 "results for the supplementary individuals"   
## 12 "coord. for the supplementary individuals"   
## 13 "cos2 for the supplementary individuals"   
## 14 "results for the supplementary categorical variables"  
## 15 "coord. for the supplementary categories"   
## 16 "v-test of the supplementary categories"   
## 17 "summary statistics"   
## 18 "mean of the variables"   
## 19 "standard error of the variables"   
## 20 "weights for the individuals"   
## 21 "weights for the variables"

pca.musk$eig

## eigenvalue percentage of variance  
## comp 1 4.997758e+01 3.010698e+01  
## comp 2 2.837146e+01 1.709124e+01  
## comp 3 8.287383e+00 4.992399e+00  
## comp 4 7.263085e+00 4.375352e+00  
## comp 5 6.078749e+00 3.661897e+00  
## comp 6 5.472472e+00 3.296670e+00  
## comp 7 4.839246e+00 2.915208e+00  
## comp 8 4.565252e+00 2.750152e+00  
## comp 9 4.130385e+00 2.488184e+00  
## comp 10 3.936034e+00 2.371105e+00  
## comp 11 3.240190e+00 1.951922e+00  
## comp 12 2.928342e+00 1.764062e+00  
## comp 13 2.471316e+00 1.488744e+00  
## comp 14 2.391953e+00 1.440935e+00  
## comp 15 2.216964e+00 1.335521e+00  
## comp 16 1.967505e+00 1.185244e+00  
## comp 17 1.776787e+00 1.070354e+00  
## comp 18 1.578755e+00 9.510573e-01  
## comp 19 1.405372e+00 8.466094e-01  
## comp 20 1.249377e+00 7.526368e-01  
## comp 21 1.179802e+00 7.107239e-01  
## comp 22 1.095461e+00 6.599162e-01  
## comp 23 1.080799e+00 6.510838e-01  
## comp 24 1.046063e+00 6.301586e-01  
## comp 25 9.876748e-01 5.949848e-01  
## comp 26 9.588911e-01 5.776452e-01  
## comp 27 8.571693e-01 5.163670e-01  
## comp 28 8.291118e-01 4.994649e-01  
## comp 29 7.769269e-01 4.680283e-01  
## comp 30 7.390279e-01 4.451975e-01  
## comp 31 6.953096e-01 4.188612e-01  
## comp 32 6.168081e-01 3.715712e-01  
## comp 33 5.948097e-01 3.583191e-01  
## comp 34 5.703469e-01 3.435825e-01  
## comp 35 5.391395e-01 3.247828e-01  
## comp 36 5.055170e-01 3.045283e-01  
## comp 37 4.482103e-01 2.700062e-01  
## comp 38 4.223681e-01 2.544386e-01  
## comp 39 3.982270e-01 2.398958e-01  
## comp 40 3.895477e-01 2.346673e-01  
## comp 41 3.701692e-01 2.229935e-01  
## comp 42 3.442244e-01 2.073641e-01  
## comp 43 2.967008e-01 1.787354e-01  
## comp 44 2.892810e-01 1.742656e-01  
## comp 45 2.696612e-01 1.624465e-01  
## comp 46 2.550494e-01 1.536442e-01  
## comp 47 2.462956e-01 1.483708e-01  
## comp 48 2.414366e-01 1.454437e-01  
## comp 49 2.244989e-01 1.352403e-01  
## comp 50 2.084392e-01 1.255658e-01  
## comp 51 1.953597e-01 1.176866e-01  
## comp 52 1.851036e-01 1.115082e-01  
## comp 53 1.815704e-01 1.093797e-01  
## comp 54 1.755921e-01 1.057784e-01  
## comp 55 1.609024e-01 9.692915e-02  
## comp 56 1.555265e-01 9.369068e-02  
## comp 57 1.488338e-01 8.965894e-02  
## comp 58 1.424031e-01 8.578498e-02  
## comp 59 1.381109e-01 8.319934e-02  
## comp 60 1.327226e-01 7.995336e-02  
## comp 61 1.266531e-01 7.629702e-02  
## comp 62 1.129636e-01 6.805038e-02  
## comp 63 1.097171e-01 6.609464e-02  
## comp 64 1.093642e-01 6.588202e-02  
## comp 65 1.021491e-01 6.153561e-02  
## comp 66 9.974644e-02 6.008822e-02  
## comp 67 9.020513e-02 5.434044e-02  
## comp 68 8.988584e-02 5.414810e-02  
## comp 69 8.389101e-02 5.053676e-02  
## comp 70 8.236977e-02 4.962034e-02  
## comp 71 7.878795e-02 4.746262e-02  
## comp 72 7.443749e-02 4.484186e-02  
## comp 73 7.125805e-02 4.292654e-02  
## comp 74 6.697956e-02 4.034913e-02  
## comp 75 6.421662e-02 3.868471e-02  
## comp 76 6.005835e-02 3.617973e-02  
## comp 77 5.753720e-02 3.466096e-02  
## comp 78 5.413688e-02 3.261258e-02  
## comp 79 5.239024e-02 3.156039e-02  
## comp 80 5.176828e-02 3.118571e-02  
## comp 81 5.094676e-02 3.069082e-02  
## comp 82 4.855246e-02 2.924847e-02  
## comp 83 4.544539e-02 2.737674e-02  
## comp 84 4.204988e-02 2.533126e-02  
## comp 85 4.048305e-02 2.438738e-02  
## comp 86 3.836112e-02 2.310911e-02  
## comp 87 3.701808e-02 2.230005e-02  
## comp 88 3.475370e-02 2.093597e-02  
## comp 89 3.385440e-02 2.039421e-02  
## comp 90 3.126338e-02 1.883336e-02  
## comp 91 3.011675e-02 1.814262e-02  
## comp 92 2.854987e-02 1.719872e-02  
## comp 93 2.764955e-02 1.665635e-02  
## comp 94 2.691424e-02 1.621340e-02  
## comp 95 2.587789e-02 1.558909e-02  
## comp 96 2.486690e-02 1.498006e-02  
## comp 97 2.386823e-02 1.437845e-02  
## comp 98 2.299698e-02 1.385360e-02  
## comp 99 2.188815e-02 1.318563e-02  
## comp 100 2.140677e-02 1.289565e-02  
## comp 101 2.041762e-02 1.229977e-02  
## comp 102 2.027382e-02 1.221314e-02  
## comp 103 1.852309e-02 1.115849e-02  
## comp 104 1.801753e-02 1.085393e-02  
## comp 105 1.720581e-02 1.036494e-02  
## comp 106 1.636234e-02 9.856830e-03  
## comp 107 1.597668e-02 9.624506e-03  
## comp 108 1.545399e-02 9.309633e-03  
## comp 109 1.530732e-02 9.221277e-03  
## comp 110 1.374337e-02 8.279141e-03  
## comp 111 1.367028e-02 8.235107e-03  
## comp 112 1.343483e-02 8.093269e-03  
## comp 113 1.300670e-02 7.835359e-03  
## comp 114 1.286063e-02 7.747365e-03  
## comp 115 1.200155e-02 7.229851e-03  
## comp 116 1.156786e-02 6.968589e-03  
## comp 117 1.140726e-02 6.871846e-03  
## comp 118 1.064333e-02 6.411642e-03  
## comp 119 1.009834e-02 6.083334e-03  
## comp 120 9.686059e-03 5.834975e-03  
## comp 121 9.298708e-03 5.601631e-03  
## comp 122 8.751412e-03 5.271935e-03  
## comp 123 8.493538e-03 5.116589e-03  
## comp 124 8.042096e-03 4.844636e-03  
## comp 125 7.761998e-03 4.675903e-03  
## comp 126 7.353854e-03 4.430033e-03  
## comp 127 6.974490e-03 4.201500e-03  
## comp 128 6.803682e-03 4.098604e-03  
## comp 129 6.436958e-03 3.877685e-03  
## comp 130 6.298220e-03 3.794109e-03  
## comp 131 6.222773e-03 3.748659e-03  
## comp 132 5.890925e-03 3.548750e-03  
## comp 133 5.548022e-03 3.342182e-03  
## comp 134 5.218384e-03 3.143605e-03  
## comp 135 5.138703e-03 3.095604e-03  
## comp 136 4.846568e-03 2.919619e-03  
## comp 137 4.655785e-03 2.804690e-03  
## comp 138 4.504794e-03 2.713731e-03  
## comp 139 4.222578e-03 2.543722e-03  
## comp 140 3.965526e-03 2.388871e-03  
## comp 141 3.756694e-03 2.263069e-03  
## comp 142 3.448713e-03 2.077538e-03  
## comp 143 3.295371e-03 1.985163e-03  
## comp 144 3.196036e-03 1.925323e-03  
## comp 145 3.002186e-03 1.808546e-03  
## comp 146 2.949815e-03 1.776997e-03  
## comp 147 2.820330e-03 1.698994e-03  
## comp 148 2.573969e-03 1.550584e-03  
## comp 149 2.392912e-03 1.441513e-03  
## comp 150 2.223895e-03 1.339696e-03  
## comp 151 2.173348e-03 1.309246e-03  
## comp 152 1.941574e-03 1.169623e-03  
## comp 153 1.743485e-03 1.050292e-03  
## comp 154 1.700865e-03 1.024618e-03  
## comp 155 1.444514e-03 8.701890e-04  
## comp 156 1.256046e-03 7.566541e-04  
## comp 157 1.212837e-03 7.306245e-04  
## comp 158 1.099712e-03 6.624773e-04  
## comp 159 1.042563e-03 6.280500e-04  
## comp 160 8.408819e-04 5.065554e-04  
## comp 161 7.718535e-04 4.649720e-04  
## comp 162 6.269767e-04 3.776968e-04  
## comp 163 5.810896e-04 3.500540e-04  
## comp 164 4.849370e-04 2.921307e-04  
## comp 165 4.140622e-04 2.494351e-04  
## comp 166 2.371420e-04 1.428566e-04  
## cumulative percentage of variance  
## comp 1 30.10698  
## comp 2 47.19822  
## comp 3 52.19062  
## comp 4 56.56597  
## comp 5 60.22787  
## comp 6 63.52454  
## comp 7 66.43975  
## comp 8 69.18990  
## comp 9 71.67808  
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## comp 11 76.00111  
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## comp 16 83.21561  
## comp 17 84.28597  
## comp 18 85.23702  
## comp 19 86.08363  
## comp 20 86.83627  
## comp 21 87.54699  
## comp 22 88.20691  
## comp 23 88.85799  
## comp 24 89.48815  
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## comp 26 90.66078  
## comp 27 91.17715  
## comp 28 91.67662  
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## comp 57 98.08920  
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## comp 105 99.77778  
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## comp 166 100.00000

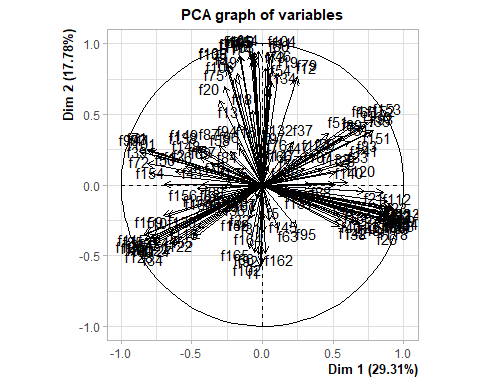
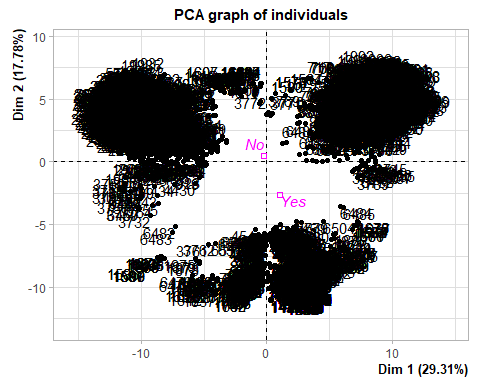
plot(pca.musk$eig[,1],type="l",main="Screenplot")



pca.musk$var$cor

## Dim.1 Dim.2 Dim.3 Dim.4 Dim.5  
## f1 0.0009138569 -0.664711359 -0.0489047411 -0.157023742 0.238652078  
## f2 -0.5663540097 0.120607984 0.3480883991 0.288110698 -0.078275527  
## f3 -0.8264889331 0.246143717 0.0266745084 0.314631752 0.047678617  
## f4 0.6483354640 0.432116462 0.0148868058 0.095899746 -0.191968275  
## f5 0.0346211415 -0.173948418 -0.2104529726 -0.050550668 -0.043508853  
## f6 -0.2698931976 -0.082292036 -0.0721567510 -0.018125942 -0.015118007  
## f7 0.9084167759 -0.158513627 0.0501903349 0.157376626 0.134433907  
## f8 -0.2621040157 0.793546180 0.0681504833 -0.044776411 0.058283840  
## f9 0.8886322629 -0.193341160 0.0290270835 -0.074092142 0.078451942  
## f10 -0.6728406488 -0.203132750 -0.0530520098 0.095090167 0.368809683  
## f11 0.0800555805 0.917186374 0.0092131703 0.059123267 0.101352915  
## f12 0.2445196538 0.727331540 0.1658949442 -0.264075668 0.313474601  
## f13 -0.1651493178 0.397819641 -0.0252931053 0.130924898 0.436062103  
## f14 -0.1735924841 0.909030904 0.0622790978 -0.090738100 0.134359921  
## f15 -0.0836155444 0.927526237 0.0258211495 -0.005941534 0.093512649  
## f16 -0.0324125334 0.292495877 -0.0710562476 0.060897394 0.094795259  
## f17 0.8293815114 -0.125160558 -0.0055486295 -0.007779939 0.024559250  
## f18 -0.0724431531 0.504116193 0.0875906174 -0.225886982 0.366175610  
## f19 0.1083777830 0.764945981 0.0938311353 -0.261211023 0.192571250  
## f20 -0.3091819588 0.581841911 0.0287007171 0.018379989 0.124631060  
## f21 0.7188276704 -0.046752711 0.1691567808 -0.288888744 0.345068156  
## f22 0.9252662264 -0.118333366 0.0539081834 -0.002307102 0.082727103  
## f23 0.8868201628 -0.102155085 0.0906216570 -0.129234110 0.198067905  
## f24 -0.6714733362 -0.316983859 0.0245827258 -0.091161420 0.115454199  
## f25 -0.8425725707 -0.355579296 -0.0134424527 -0.054601909 0.155084970  
## f26 0.8337783899 -0.282974318 0.0666798813 0.052567638 0.115375940  
## f27 0.5722078539 -0.082542378 0.0317707976 0.612504170 0.272547900  
## f28 0.5283593791 0.122277157 0.1224697562 0.266463235 0.125510384  
## f29 0.3848657143 0.203239654 0.0167242238 0.103472070 -0.132641826  
## f30 -0.8311551450 -0.370854020 -0.0217476045 -0.063073178 0.196592687  
## f31 0.0051525911 -0.335571170 0.3979029656 0.186498035 -0.008325708  
## f32 -0.0868224814 -0.222975952 0.8683824011 -0.004997071 -0.123627193  
## f33 0.6216847071 0.101802583 -0.4265501783 0.077160623 -0.060286728  
## f34 -0.7253760078 -0.432859249 -0.0266010399 -0.021392129 0.271141114  
## f35 0.7752391829 0.348321358 -0.0548771593 0.103385007 -0.268273708  
## f36 -0.0938971849 -0.208312148 -0.4934537277 -0.028812385 0.111540158  
## f37 0.2398451235 0.291883733 -0.1171703544 0.083420613 -0.221499231  
## f38 0.5867210876 -0.262820169 0.0249491825 0.344691165 0.189072708  
## f39 -0.8369902468 0.173409196 -0.0613537116 -0.047246090 -0.114440749  
## f40 0.5459230336 -0.223662504 0.0357949929 0.571624428 0.334398983  
## f41 -0.8167145604 0.262289424 0.1304967641 0.266269606 -0.052958551  
## f42 -0.0923320339 -0.185365524 0.5143889286 -0.187497677 0.033253449  
## f43 -0.4180252073 -0.004895026 -0.0501856343 0.131076561 0.450359980  
## f44 -0.0294859554 0.940858466 0.0344248091 -0.014860060 0.089984603  
## f45 -0.0782115715 0.922750546 0.0913796806 -0.115218896 0.164713582  
## f46 0.0683361910 0.818939396 -0.0155168248 0.088981117 0.122049392  
## f47 0.1806762229 0.188266312 -0.1570658787 -0.168031506 -0.072828214  
## f48 0.7000227573 -0.225554795 0.0764252818 -0.180016221 0.243820393  
## f49 -0.1948078085 0.756110611 0.0848647342 -0.214797367 0.119252344  
## f50 -0.6175010520 0.094355191 -0.0234806751 0.046108783 0.294679589  
## f51 0.4701152867 0.337655274 0.2120008982 -0.388570923 0.400511301  
## f52 0.9204010432 -0.130094573 0.0400462950 -0.056335836 0.065881269  
## f53 0.9219832457 -0.173135482 0.0651603785 0.022728232 0.120898191  
## f54 0.0710102405 0.715197559 0.0485700961 0.079060106 0.004141135  
## f55 -0.4784645163 -0.321472896 0.0503762796 -0.031234850 0.049721029  
## f56 0.5082781829 -0.095665797 0.1145595346 -0.081631497 0.137711541  
## f57 0.8620924181 -0.180775261 0.0090130099 0.291665449 0.211458701  
## f58 -0.2498007810 0.226157909 0.1902903684 0.461245526 0.033729963  
## f59 0.1450304550 0.076997821 -0.0132967820 0.060378066 -0.084952226  
## f60 -0.7922057746 -0.373038838 -0.0428697897 0.021455557 0.280857354  
## f61 0.6361366310 0.262741155 -0.0564961601 0.132395334 -0.170680994  
## f62 -0.3053050776 -0.027619561 0.8649119963 0.074907108 -0.135515870  
## f63 0.1050359612 -0.339677799 -0.5619136953 -0.093569710 0.226430816  
## f64 -0.7936118447 -0.331278550 -0.0351621160 -0.079742642 0.151790924  
## f65 0.6737894567 0.433134639 -0.0502344805 0.113036297 -0.247989008  
## f66 -0.0399989887 -0.560928294 -0.1823177239 -0.148987384 0.187865462  
## f67 -0.0416604450 -0.115585697 -0.1835630725 0.005433752 -0.061437264  
## f68 -0.2751383736 0.030684060 0.0079417829 0.535240473 0.231617029  
## f69 -0.3720309552 0.162368718 -0.4889026476 -0.100313745 0.013286928  
## f70 -0.2737770047 0.056346155 0.0538617877 0.710408231 0.314801119  
## f71 -0.8308811018 0.263646693 0.0642796421 0.289297182 -0.013005518  
## f72 -0.8122384555 0.086984833 0.1204746072 0.050658693 -0.117829574  
## f73 0.0294345993 0.815284842 0.0030072302 0.091717709 0.219727056  
## f74 -0.0800943280 0.865560313 0.1278777667 -0.177621193 0.246782596  
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## f76 0.0464645222 0.220180902 -0.1069265416 -0.131798209 0.036860925  
## f77 0.8754991679 -0.204243659 0.0083414471 -0.031770544 0.050603379  
## f78 -0.1651811126 0.907962322 0.0305251319 -0.053615740 0.082347195  
## f79 0.2554773235 0.746499454 0.1290702219 -0.250685311 0.257863522  
## f80 0.0584743763 0.894026351 0.0430445395 0.031492940 0.011050738  
## f81 0.8563732938 -0.187899045 0.0997769130 -0.138475860 0.223215464  
## f82 0.9202960581 -0.143067578 0.0572985197 0.078828161 0.108841494  
## f83 0.6693278556 0.181701627 0.1686178213 -0.355847797 0.314034793  
## f84 -0.1601624361 0.143784029 0.0951619039 -0.014004065 -0.106777334  
## f85 -0.8605808241 -0.320264436 -0.0297193106 -0.008286128 0.220650542  
## f86 0.8948465407 -0.200527889 0.0563051380 0.131428009 0.126739049  
## f87 -0.3233461363 0.298182794 0.0451083469 0.582445092 0.112334111  
## f88 0.3619465513 0.049254241 0.1109778925 0.150502839 0.062264521  
## f89 0.5770041445 0.328230799 0.0172448229 0.094233069 -0.143939148  
## f90 -0.7774271755 -0.370028584 -0.0504696965 -0.073441495 0.139368783  
## f91 -0.1897177180 -0.135196247 0.7914156138 0.118926066 -0.067914137  
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## f93 0.8029860140 0.361992472 -0.0764276974 0.120254268 -0.211116408  
## f94 -0.1932262736 0.322766054 -0.0329595639 0.160316142 0.312673135  
## f95 0.2306965087 -0.301702312 0.0744061769 -0.099459842 -0.086763321  
## f96 -0.1583915222 0.252952985 -0.6768219104 0.141779494 -0.028881175  
## f97 0.0292798365 0.264914525 -0.1355537387 0.051293931 -0.156660638  
## f98 0.8967391672 -0.203718776 0.0264741261 0.010728548 0.055070734  
## f99 -0.8955835161 0.243366412 -0.0134088748 0.058624237 -0.077983554  
## f100 0.8459044824 -0.218468968 0.0127504292 0.303942757 0.237281983  
## f101 -0.7713150303 0.235179328 0.2342474413 0.275921525 -0.071831573  
## f102 0.0179517740 -0.584606090 0.3593390250 -0.223859643 0.231108067  
## f103 -0.0542634666 0.885181460 -0.0047156663 0.051654277 0.150240703  
## f104 0.0482641922 0.937343223 0.0183341667 0.033930635 0.096060447  
## f105 -0.0717209237 0.933058749 0.0468806588 -0.041765041 0.102915179  
## f106 -0.2043395871 0.739791661 -0.0006322385 -0.039173885 0.116871298  
## f107 0.3191818239 0.167199135 -0.0512501440 -0.227145459 0.011497886  
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## f109 -0.2540711344 0.842254892 0.0258152292 0.001577292 0.117123440  
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## f118 0.8465011667 -0.251288137 0.0588978382 0.172303112 0.125430767  
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## f123 -0.6566482526 -0.380140239 -0.0269068874 -0.051135143 0.109210114  
## f124 0.3139810544 0.120422062 -0.4781368183 0.178791327 0.053518965  
## f125 -0.0913349809 -0.043984466 0.7730455884 0.140774389 -0.215251058  
## f126 -0.1446284036 -0.204474833 -0.1315632381 0.065435671 0.134545372  
## f127 -0.6543713724 -0.369178867 -0.0532976564 0.088051142 0.359495259  
## f128 -0.7969332006 -0.414160945 -0.0248759235 -0.048716038 0.223943159  
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## f130 0.7296812889 0.389236141 -0.0401096579 0.108399711 -0.271802645  
## f131 0.1635607602 -0.108974059 0.3840504910 0.017979352 -0.270195386  
## f132 0.0401699399 0.242634346 0.0640711023 0.137250305 -0.327280681  
## f133 0.4187063172 0.090644259 0.1750033386 -0.366321342 0.430873208  
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## f135 -0.2632431422 0.830541990 0.0780957637 -0.160505072 0.197908178  
## f136 -0.5024376360 0.126175459 -0.0651137269 0.243358413 0.045451504  
## f137 0.7332308047 -0.223729310 0.0325823643 0.177564534 0.090712372  
## f138 -0.4712883542 0.262386076 -0.0457730804 -0.030150117 -0.128077770  
## f139 0.8591898101 -0.226346471 0.0756215501 -0.077345268 0.150672369  
## f140 0.5089833572 -0.013503952 0.1352800452 -0.317725546 0.213943002  
## f141 0.6246648626 0.138730030 0.1435702597 -0.369550974 0.275235111  
## f142 0.5379270494 -0.250140802 0.0192196779 0.474457441 0.277197681  
## f143 0.8823692816 -0.223368739 0.0329305700 0.207854072 0.192216371  
## f144 0.9061849311 -0.212436489 0.0446647320 0.078582020 0.116725653  
## f145 0.0593708885 -0.296954855 0.2628466484 0.104637474 -0.028284431  
## f146 0.0765270995 -0.028774482 0.1179955877 0.169195518 -0.020536554  
## f147 0.0436182308 0.139155824 0.0966459644 0.088569826 -0.079559695  
## f148 -0.4555878527 0.200596808 0.0467341318 0.703627947 0.251988441  
## f149 -0.4679814145 0.286086622 0.0402158059 0.635852150 0.161542959  
## f150 0.5606313025 -0.164115301 0.0393101095 0.624042359 0.331378338  
## f151 0.7204789759 0.232873204 -0.1356529038 0.091580709 -0.250938036  
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## f163 0.2001974205 -0.131374319 0.0024098997 0.188025892 -0.222184125  
## f164 0.0049032310 -0.411214358 0.1234789631 0.035782826 0.023259513  
## f165 -0.0939968104 -0.475563620 0.0638213494 -0.146006597 0.252223885  
## f166 0.0085175332 0.161374623 0.5014063058 -0.077237946 -0.070967572

nd = 25   
pca.musk.sign <- PCA(Musk, ncp=nd, quali.sup=167, scale.unit = FALSE)



pca.musk <- (cbind(as.data.frame(pca.musk.sign$ind$coord),Musk[167]))

### Operaciones para aplicar los algoritmos de clasificación linear:

En primer lugar, hemos utilizado, tal y como recomendado, los algoritmos de Logistic Regression, LDA y QDA, intentando buscar entre los tres lo que tenia la más pequeña Training Error y Test Error. Para llegar a los resultados de comparacion entre los tres metodos, primero hemos dividido el dataset de Musk entre Training y Test, dejando aproximadamente el 66% para Training.

#### Logistic Regression

Para la parte del metodo de logistic regression, primero hemos aplicado el GLM (generalized linear models), con lo cual hemos descubierto que algunas variables, como f1, f17, f32, f33, pueden no ser estadisticamente interesantes, sin embargo no las hemos ignorado de momento. Enseguida, intentamos simplificar un poco el modelo quitando las variables no significativas. Utilizamos función de step(). Pero, por tardar mucho en ejecutarse, al final no lo hemos considerado y utilizamos el resultado de la función GLM.

A través de la función musk.accs (con la cual usa por defecto utiliza predicción probabilistica al 50%), hemos intentado hacer predicciones probabilisticas para los datos de training y los datos de test. Vemos un resultado de error en training de 4.12% y de error en test de 4.23%.

#### LDA

En la aplicación del LDA, vemos un error en training del 5,47% y error en test de 5,28%, que, en estos momentos, ha sido peor que lo de la logistic regression. Mismo utilizando Cross Validation Leave-one-out (CV=TRUE), obtenemos error en training de 5.97% y en test de 5,78%.

#### QDA

En la aplicación del QDA, vemos un error en training de 1,13% y error en test de 3.50%. En este caso entendemos que este metodo es el mejor en el caso de predicir si un nuevo dato es Musk o No Musk. Cuando hemos realizado la aplicación del mismo metodo con Cross Validation Leave-one-out (CV=TRUE), obtenemos error en training de 3.16% y en test de 5,37% que, aun que sean mas grandes que sin CV leave-one-out, nos han parecido resultados mas interesantes que en los demas metodos.

set.seed(17)  
  
#Primera acción es de dividir el dataset de Musk entre Training y Test. Dejamos aprox el 66% para training.  
N <- nrow(Musk)  
learn <- sample(1:N, round(2\*N/3))  
  
nlearn <- length(learn)  
ntest <- N - nlearn  
  
# Logistic Regression.  
  
musk.glm <- glm (class ~ ., data = Musk[learn,], family = "binomial")  
summary(musk.glm)

##   
## Call:  
## glm(formula = class ~ ., family = "binomial", data = Musk[learn,   
## ])  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -4.4005 -0.1418 -0.0327 -0.0014 3.7455   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -5.702674 0.328114 -17.380 < 2e-16 \*\*\*  
## f1 -5.381289 1.529228 -3.519 0.000433 \*\*\*  
## f2 2.010803 0.702180 2.864 0.004188 \*\*   
## f3 -6.078837 1.947928 -3.121 0.001804 \*\*   
## f4 -1.718929 0.666470 -2.579 0.009904 \*\*   
## f5 0.105033 0.176813 0.594 0.552490   
## f6 -1.063543 0.472219 -2.252 0.024308 \*   
## f7 -0.370406 2.797933 -0.132 0.894679   
## f8 0.954873 0.414168 2.306 0.021138 \*   
## f9 -4.528862 1.494978 -3.029 0.002451 \*\*   
## f10 -2.565531 0.783719 -3.274 0.001062 \*\*   
## f11 1.287954 0.972984 1.324 0.185598   
## f12 -1.701610 1.908586 -0.892 0.372631   
## f13 -0.098650 0.657629 -0.150 0.880758   
## f14 -3.306075 2.095109 -1.578 0.114566   
## f15 -2.282910 1.277144 -1.788 0.073855 .   
## f16 -0.798349 0.277380 -2.878 0.004000 \*\*   
## f17 3.985112 0.824589 4.833 1.35e-06 \*\*\*  
## f18 -0.388322 0.360015 -1.079 0.280754   
## f19 -0.597653 1.204321 -0.496 0.619713   
## f20 0.163146 0.534814 0.305 0.760327   
## f21 1.429630 1.111457 1.286 0.198350   
## f22 -4.290842 3.096444 -1.386 0.165829   
## f23 1.078575 1.640448 0.657 0.510867   
## f24 0.018934 0.298214 0.063 0.949374   
## f25 -1.692618 0.952908 -1.776 0.075689 .   
## f26 -2.920595 0.955211 -3.058 0.002232 \*\*   
## f27 1.852671 1.420001 1.305 0.191996   
## f28 -0.725800 0.360581 -2.013 0.044129 \*   
## f29 -1.757690 0.873233 -2.013 0.044130 \*   
## f30 -2.007439 1.864170 -1.077 0.281546   
## f31 -0.544906 0.557669 -0.977 0.328512   
## f32 -3.171984 0.957586 -3.312 0.000925 \*\*\*  
## f33 -4.381489 0.992765 -4.413 1.02e-05 \*\*\*  
## f34 -0.412017 0.631458 -0.652 0.514088   
## f35 -4.288952 1.130183 -3.795 0.000148 \*\*\*  
## f36 -1.959890 0.854947 -2.292 0.021882 \*   
## f37 -0.939228 0.404713 -2.321 0.020302 \*   
## f38 2.178366 1.324622 1.645 0.100069   
## f39 -0.875680 0.683432 -1.281 0.200089   
## f40 -0.036249 2.502183 -0.014 0.988442   
## f41 4.389820 2.436094 1.802 0.071547 .   
## f42 -2.243940 0.695478 -3.226 0.001253 \*\*   
## f43 1.695157 0.783626 2.163 0.030524 \*   
## f44 -0.167229 2.023937 -0.083 0.934149   
## f45 -3.645215 2.343908 -1.555 0.119902   
## f46 0.313719 0.461006 0.681 0.496182   
## f47 -0.934886 0.303861 -3.077 0.002093 \*\*   
## f48 1.008247 0.799351 1.261 0.207189   
## f49 -0.459910 0.672305 -0.684 0.493925   
## f50 1.681636 0.675258 2.490 0.012761 \*   
## f51 1.730491 0.912238 1.897 0.057832 .   
## f52 6.784532 2.180572 3.111 0.001862 \*\*   
## f53 5.911245 2.163966 2.732 0.006301 \*\*   
## f54 -0.027044 0.226582 -0.119 0.904994   
## f55 -0.459884 0.512663 -0.897 0.369693   
## f56 0.508541 0.374557 1.358 0.174555   
## f57 -5.628228 2.724301 -2.066 0.038835 \*   
## f58 -2.141243 0.491425 -4.357 1.32e-05 \*\*\*  
## f59 2.147231 0.780031 2.753 0.005910 \*\*   
## f60 -0.872123 1.255994 -0.694 0.487451   
## f61 -0.945472 0.503448 -1.878 0.060382 .   
## f62 0.119847 0.849699 0.141 0.887833   
## f63 -0.178404 0.984238 -0.181 0.856163   
## f64 0.516413 0.974464 0.530 0.596150   
## f65 -1.754397 1.059924 -1.655 0.097882 .   
## f66 5.164944 1.561183 3.308 0.000938 \*\*\*  
## f67 -0.788700 0.583943 -1.351 0.176809   
## f68 1.090126 1.528538 0.713 0.475733   
## f69 0.003178 0.421479 0.008 0.993985   
## f70 -0.439665 1.862301 -0.236 0.813365   
## f71 4.753297 2.774949 1.713 0.086725 .   
## f72 -2.616417 1.048501 -2.495 0.012582 \*   
## f73 -1.883487 0.859928 -2.190 0.028504 \*   
## f74 2.494244 1.865969 1.337 0.181320   
## f75 -1.423614 0.782637 -1.819 0.068912 .   
## f76 0.402544 0.201767 1.995 0.046032 \*   
## f77 -0.261287 1.253471 -0.208 0.834877   
## f78 2.411094 1.118125 2.156 0.031055 \*   
## f79 1.234366 1.971624 0.626 0.531272   
## f80 0.028554 0.652844 0.044 0.965114   
## f81 -2.887384 1.242312 -2.324 0.020115 \*   
## f82 -1.960960 3.550748 -0.552 0.580766   
## f83 -1.283223 1.046917 -1.226 0.220306   
## f84 0.725446 0.363628 1.995 0.046041 \*   
## f85 3.550071 1.102550 3.220 0.001282 \*\*   
## f86 -3.164309 1.736306 -1.822 0.068389 .   
## f87 3.874594 0.994493 3.896 9.78e-05 \*\*\*  
## f88 -0.591281 0.278878 -2.120 0.033988 \*   
## f89 0.601462 0.717774 0.838 0.402056   
## f90 0.268886 1.125451 0.239 0.811172   
## f91 -0.211772 0.459240 -0.461 0.644701   
## f92 0.931603 0.965664 0.965 0.334681   
## f93 3.433467 1.538174 2.232 0.025604 \*   
## f94 1.291441 0.467186 2.764 0.005705 \*\*   
## f95 0.331815 0.681851 0.487 0.626515   
## f96 -1.983343 0.545815 -3.634 0.000279 \*\*\*  
## f97 0.467189 0.457260 1.022 0.306917   
## f98 -6.142878 1.491773 -4.118 3.82e-05 \*\*\*  
## f99 6.424759 1.290486 4.979 6.41e-07 \*\*\*  
## f100 -1.334008 2.888672 -0.462 0.644220   
## f101 -4.824164 1.556046 -3.100 0.001933 \*\*   
## f102 -1.033160 1.031098 -1.002 0.316344   
## f103 2.916009 1.188855 2.453 0.014175 \*   
## f104 -2.522495 1.854888 -1.360 0.173856   
## f105 2.753908 2.152266 1.280 0.200707   
## f106 -0.419966 0.447173 -0.939 0.347650   
## f107 -0.865251 0.258348 -3.349 0.000811 \*\*\*  
## f108 1.208285 0.493426 2.449 0.014335 \*   
## f109 0.669577 0.889481 0.753 0.451587   
## f110 0.651326 1.706087 0.382 0.702635   
## f111 -0.912179 0.949697 -0.960 0.336806   
## f112 -3.152130 1.727956 -1.824 0.068123 .   
## f113 4.380637 2.001814 2.188 0.028645 \*   
## f114 -0.595450 2.404219 -0.248 0.804391   
## f115 -1.665018 0.640217 -2.601 0.009303 \*\*   
## f116 0.679990 0.242025 2.810 0.004960 \*\*   
## f117 0.882501 0.734600 1.201 0.229621   
## f118 2.784536 0.863442 3.225 0.001260 \*\*   
## f119 10.215803 2.046216 4.993 5.96e-07 \*\*\*  
## f120 -1.842254 0.895156 -2.058 0.039588 \*   
## f121 1.960041 1.416382 1.384 0.166408   
## f122 1.698201 0.693608 2.448 0.014351 \*   
## f123 -2.327940 1.068065 -2.180 0.029288 \*   
## f124 -0.524151 0.519527 -1.009 0.313022   
## f125 -2.932864 0.761151 -3.853 0.000117 \*\*\*  
## f126 1.943540 0.613810 3.166 0.001544 \*\*   
## f127 -1.572275 0.950999 -1.653 0.098272 .   
## f128 2.307725 1.561120 1.478 0.139341   
## f129 0.934771 0.587109 1.592 0.111349   
## f130 2.964452 0.941461 3.149 0.001640 \*\*   
## f131 -0.914358 0.647634 -1.412 0.157996   
## f132 -0.590537 0.389055 -1.518 0.129046   
## f133 -0.681166 0.633330 -1.076 0.282137   
## f134 0.629173 1.019881 0.617 0.537295   
## f135 0.297820 1.117695 0.266 0.789886   
## f136 -1.411568 0.822179 -1.717 0.086004 .   
## f137 -0.602463 0.861660 -0.699 0.484434   
## f138 -1.247435 0.473007 -2.637 0.008358 \*\*   
## f139 -3.218164 1.272292 -2.529 0.011425 \*   
## f140 1.104975 0.561328 1.969 0.049010 \*   
## f141 0.952328 0.873845 1.090 0.275796   
## f142 -1.550684 2.027775 -0.765 0.444437   
## f143 -0.687968 2.530068 -0.272 0.785686   
## f144 6.568102 2.001309 3.282 0.001031 \*\*   
## f145 -0.270433 0.398918 -0.678 0.497826   
## f146 -0.654371 0.415004 -1.577 0.114845   
## f147 -0.157991 0.177210 -0.892 0.372636   
## f148 2.407048 1.683378 1.430 0.152748   
## f149 -5.786625 1.363944 -4.243 2.21e-05 \*\*\*  
## f150 0.283548 2.021251 0.140 0.888436   
## f151 4.175412 1.296631 3.220 0.001281 \*\*   
## f152 1.369497 1.261970 1.085 0.277831   
## f153 -1.729993 1.830087 -0.945 0.344502   
## f154 -0.991464 1.170144 -0.847 0.396828   
## f155 3.060766 0.942073 3.249 0.001158 \*\*   
## f156 2.088022 1.055873 1.978 0.047982 \*   
## f157 -0.019068 0.194741 -0.098 0.922001   
## f158 -0.603068 0.277396 -2.174 0.029703 \*   
## f159 0.333393 0.469788 0.710 0.477911   
## f160 0.395788 0.572030 0.692 0.489000   
## f161 0.460112 0.554063 0.830 0.406294   
## f162 -2.045744 0.817241 -2.503 0.012306 \*   
## f163 -1.780876 0.665444 -2.676 0.007446 \*\*   
## f164 -0.931454 0.545782 -1.707 0.087888 .   
## f165 -0.594256 0.784742 -0.757 0.448893   
## f166 0.581177 0.423630 1.372 0.170095   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 3814.53 on 4386 degrees of freedom  
## Residual deviance: 952.09 on 4220 degrees of freedom  
## AIC: 1286.1  
##   
## Number of Fisher Scoring iterations: 10

#Tarda mucho en ejecutarse, al final lo acabamos dejando y utilizamos el resultado del glm.  
#musk.glm.step <- step(musk.glm)  
  
# La siguiente rutina de función logistica lo que hace es de predicciones probabilisticas para los datos de training y los datos de test.  
musk.accs <- function (P=0.5)  
{  
 muskM1.pred <- NULL  
 muskM1.pred[musk.glm$fitted.values<P] <- 0  
 muskM1.pred[musk.glm$fitted.values>=P] <- 1  
   
 muskM1.pred <- factor(muskM1.pred, labels=c("No Musk","Musk"))  
   
 cat("TRAINING ERROR:")  
 print(M1.TRtable <- table(Truth=Musk[learn,]$class,Pred=muskM1.pred))  
   
 print(100\*(1-sum(diag(M1.TRtable))/nlearn))  
   
 muskM1test <- predict(musk.glm, newdata=Musk[-learn,],type="response")  
 muskM1.pred.test <- NULL  
 muskM1.pred.test[muskM1test<P] <- 0  
 muskM1.pred.test[muskM1test>=P] <- 1  
 muskM1.pred.test <- factor(muskM1.pred.test, labels=c("No Musk","Musk"))  
   
 cat("TESTING ERROR:")  
 print(M1.TEtable <- table(Truth=Musk[-learn,]$class,Pred=muskM1.pred.test))  
   
 print(100\*(1-sum(diag(M1.TEtable))/ntest))  
}  
  
musk.accs()

## TRAINING ERROR: Pred  
## Truth No Musk Musk  
## No 3633 65  
## Yes 116 573  
## [1] 4.125826  
## TESTING ERROR: Pred  
## Truth No Musk Musk  
## No 1824 42  
## Yes 51 277  
## [1] 4.238833

#Evaluaciones de LDA y QDA  
library(MASS)

##   
## Attaching package: 'MASS'

## The following object is masked from 'package:dplyr':  
##   
## select

# 1.Aplicación del LDA  
musk.lda.learn <- lda(class ~ ., Musk[learn,], CV = FALSE)  
musk.lda.train <- predict(musk.lda.learn,newdata=Musk[learn,])  
#plot(musk.lda.learn)  
#plot(musk.lda.train)  
  
#Calcular los errores de LDA y las predicciones en training y test data  
cat("LDA TRAINING ERROR:")

## LDA TRAINING ERROR:

(tab <- table(Truth=Musk[learn,]$class, Pred=musk.lda.train$class))

## Pred  
## Truth No Yes  
## No 3641 57  
## Yes 183 506

(error.LOOCV <- 100\*(1-sum(tab[row(tab)==col(tab)])/sum(tab)))

## [1] 5.470709

musk.lda.test <- predict(musk.lda.learn, newdata=Musk[-learn,], type = "response")  
cat("TESTING ERROR:")

## TESTING ERROR:

(tab <- table(Truth=Musk[-learn,]$class, Pred=musk.lda.test$class))

## Pred  
## Truth No Yes  
## No 1836 30  
## Yes 86 242

(error.LOOCV <- 100\*(1-sum(tab[row(tab)==col(tab)])/sum(tab)))

## [1] 5.287147

#Leave-one-out  
musk.lda.learn.loo <- lda(class ~ ., Musk[learn,], CV = TRUE)  
(tab <- table(Truth=Musk[learn,]$class, Pred=musk.lda.learn.loo$class))

## Pred  
## Truth No Yes  
## No 3630 68  
## Yes 194 495

(error.LOOCV <- 100\*(1-sum(tab[row(tab)==col(tab)])/sum(tab)))

## [1] 5.972191

musk.lda.test.loo <- lda(class ~ ., Musk[-learn,], CV = TRUE)  
(tab <- table(Truth=Musk[-learn,]$class, Pred=musk.lda.test.loo$class))

## Pred  
## Truth No Yes  
## No 1830 36  
## Yes 91 237

(error.LOOCV <- 100\*(1-sum(tab[row(tab)==col(tab)])/sum(tab)))

## [1] 5.788514

# 2.Quadratic Discriminant Analysis  
  
musk.qda.learn <- qda (class ~ ., Musk[learn,], CV = FALSE)  
musk.qda.train <- predict(musk.qda.learn)  
  
#Calcular los errores de QDA y las predicciones en training y test data  
musk.qda.train <- predict(musk.qda.learn,newdata=Musk[learn,])  
cat("QDA TRAINING ERROR:")

## QDA TRAINING ERROR:

(tab <- table(Truth=Musk[learn,]$class, Pred=musk.qda.train$class))

## Pred  
## Truth No Yes  
## No 3682 16  
## Yes 34 655

(error.LOOCV <- 100\*(1-sum(tab[row(tab)==col(tab)])/sum(tab)))

## [1] 1.139731

musk.qda.test <- predict(musk.qda.learn, newdata=Musk[-learn,], type = "response")  
cat("QDA TEST ERROR:")

## QDA TEST ERROR:

(tab <- table(Truth=Musk[-learn,]$class, Pred=musk.qda.test$class))

## Pred  
## Truth No Yes  
## No 1852 14  
## Yes 63 265

(error.LOOCV <- 100\*(1-sum(tab[row(tab)==col(tab)])/sum(tab)))

## [1] 3.509572

#Leave-one-out  
musk.qda.learn.loo <- qda(class ~ ., Musk[learn,], CV = TRUE)  
(tab <- table(Truth=Musk[learn,]$class, Pred=musk.qda.learn.loo$class))

## Pred  
## Truth No Yes  
## No 3679 19  
## Yes 120 569

(error.LOOCV <- 100\*(1-sum(tab[row(tab)==col(tab)])/sum(tab)))

## [1] 3.168452

musk.qda.test.loo <- qda(class ~ ., Musk[-learn,], CV = TRUE)  
(tab <- table(Truth=Musk[-learn,]$class, Pred=musk.qda.test.loo$class))

## Pred  
## Truth No Yes  
## No 1866 0  
## Yes 118 210

(error.LOOCV <- 100\*(1-sum(tab[row(tab)==col(tab)])/sum(tab)))

## [1] 5.378304