Datos Capitulo 3

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Datos de la Liga Iberdrola 2020/2021 (https://rfevb-web.dataproject.com/CompetitionHome.aspx?ID=68)

Liga Iberdrola 2020/2021

```
library(readxl)
partidos2021 = read_excel("Partidos_20_21.xlsx", sheet = 1, range= "A2:AA266", col_names=T)
head(partidos2021)
```

```
## # A tibble: 6 x 27
##   Equipo         `Sets jugados`   Tot    BP     G `G-P` `Saque-Tot` `Saque-Pts`
##   <chr>                   <dbl> <dbl> <dbl> <dbl> <dbl>       <dbl>       <dbl>
## 1 Cajasol Juvasa              5    71    27    44    30         107           6
## 2 Cajasol Juvasa              4    68    29    39    40          95           3
## 3 Cajasol Juvasa              5    79    37    42    39         102           7
## 4 Cajasol Juvasa              4    58    22    36    20          89           6
## 5 Cajasol Juvasa              3    27    11    16   -10          42           2
## 6 Cajasol Juvasa              3    64    40    24    37          74          12
## # ... with 19 more variables: Saque-Err <dbl>, Saque-Pts por set <dbl>,
## #   Saque-Efic <dbl>, Recep-Tot <dbl>, Recep-Err <dbl>, Recep-Neg <dbl>,
## #   Recep-Exc <dbl>, Recep-ExcPorc <dbl>, Recep-Efic <dbl>, Ataque-Tot <dbl>,
## #   Ataque-Err <dbl>, Ataque-Blo <dbl>, Ataque-Exc <dbl>, Ataque-ExcPorc <dbl>,
## #   Ataque-Efic <dbl>, Bloqueo-Red <dbl>, Bloqueo-Pts <dbl>,
## #   Bloqueo-Puntos por set <dbl>, Ganado/Perdido <dbl>
```

Estudio descriptivo de los datos

```
str(partidos2021)
```

```
## tibble [264 x 27] (S3: tbl_df/tbl/data.frame)
##  $ Equipo               : chr [1:264] "Cajasol Juvasa" "Cajasol Juvasa" "Cajasol Juvasa" "Cajasol Ju
##  $ Sets jugados         : num [1:264] 5 4 5 4 3 3 5 5 3 4 ...
##  $ Tot                  : num [1:264] 71 68 79 58 27 64 64 75 42 59 ...
##  $ BP                   : num [1:264] 27 29 37 22 11 40 25 33 10 25 ...
##  $ G                    : num [1:264] 44 39 42 36 16 24 39 42 32 34 ...
##  $ G-P                  : num [1:264] 30 40 39 20 -10 37 7 23 11 10 ...
##  $ Saque-Tot            : num [1:264] 107 95 102 89 42 74 81 100 50 82 ...
```

```
##  $ Saque-Pts             : num [1:264] 6 3 7 6 2 12 8 4 2 7 ...
##  $ Saque-Err             : num [1:264] 13 9 11 11 3 9 7 14 7 14 ...
##  $ Saque-Pts por set     : num [1:264] 1.2 0.8 1.4 1.5 0.7 4 1.6 0.8 0.7 1.8 ...
##  $ Saque-Efic            : num [1:264] -0.07 -0.06 -0.04 -0.06 -0.02 0.04 0.01 -0.1 -0.1 -0.09 ...
##  $ Recep-Tot             : num [1:264] 100 80 91 89 67 49 104 89 74 84 ...
##  $ Recep-Err             : num [1:264] 9 3 2 6 13 1 13 6 6 10 ...
##  $ Recep-Neg             : num [1:264] 17 34 13 29 12 13 47 24 36 10 ...
##  $ Recep-Exc             : num [1:264] 61 32 61 23 14 20 24 45 16 53 ...
##  $ Recep-ExcPorc         : num [1:264] 0.61 0.4 0.67 0.26 0.21 0.41 0.23 0.51 0.22 0.63 ...
##  $ Recep-Efic            : num [1:264] 0.52 0.36 0.65 0.19 0.01 0.39 0.11 0.44 0.14 0.51 ...
##  $ Ataque-Tot            : num [1:264] 182 134 155 136 98 98 147 169 106 137 ...
##  $ Ataque-Err            : num [1:264] 10 8 19 8 19 7 20 15 10 14 ...
##  $ Ataque-Blo            : num [1:264] 9 8 8 13 2 10 17 17 8 11 ...
##  $ Ataque-Exc            : num [1:264] 54 53 58 43 24 47 44 57 35 43 ...
##  $ Ataque-ExcPorc        : num [1:264] 0.3 0.4 0.37 0.32 0.24 0.48 0.3 0.34 0.33 0.31 ...
##  $ Ataque-Efic           : num [1:264] 0.19 0.28 0.2 0.16 0.03 0.31 0.05 0.15 0.16 0.13 ...
##  $ Bloqueo-Red           : num [1:264] 0 0 0 0 0 0 0 0 0 0 ...
##  $ Bloqueo-Pts           : num [1:264] 11 12 14 9 1 5 12 14 5 9 ...
##  $ Bloqueo-Puntos por set: num [1:264] 2.2 3 2.8 2.3 0.3 1.7 2.4 2.8 1.7 2.3 ...
##  $ Ganado/Perdido        : num [1:264] 0 1 0 0 0 1 0 0 0 0 ...
```

Primero cambiamos la variable *Ganado/Perdido* a una variable dicotómica de tipo factor con valores 0 y 1 correspondientes a si el equipo ha perdido o ha ganado el partido.

```
partidos2021$`Ganado/Perdido` = as.factor(partidos2021$`Ganado/Perdido`)
str(partidos2021)
```

```
## tibble [264 x 27] (S3: tbl_df/tbl/data.frame)
##  $ Equipo                : chr [1:264] "Cajasol Juvasa" "Cajasol Juvasa" "Cajasol Juvasa" "Cajasol Ju
##  $ Sets jugados          : num [1:264] 5 4 5 4 3 3 5 5 3 4 ...
##  $ Tot                   : num [1:264] 71 68 79 58 27 64 64 75 42 59 ...
##  $ BP                    : num [1:264] 27 29 37 22 11 40 25 33 10 25 ...
##  $ G                     : num [1:264] 44 39 42 36 16 24 39 42 32 34 ...
##  $ G-P                   : num [1:264] 30 40 39 20 -10 37 7 23 11 10 ...
##  $ Saque-Tot             : num [1:264] 107 95 102 89 42 74 81 100 50 82 ...
##  $ Saque-Pts             : num [1:264] 6 3 7 6 2 12 8 4 2 7 ...
##  $ Saque-Err             : num [1:264] 13 9 11 11 3 9 7 14 7 14 ...
##  $ Saque-Pts por set     : num [1:264] 1.2 0.8 1.4 1.5 0.7 4 1.6 0.8 0.7 1.8 ...
##  $ Saque-Efic            : num [1:264] -0.07 -0.06 -0.04 -0.06 -0.02 0.04 0.01 -0.1 -0.1 -0.09 ...
##  $ Recep-Tot             : num [1:264] 100 80 91 89 67 49 104 89 74 84 ...
##  $ Recep-Err             : num [1:264] 9 3 2 6 13 1 13 6 6 10 ...
##  $ Recep-Neg             : num [1:264] 17 34 13 29 12 13 47 24 36 10 ...
##  $ Recep-Exc             : num [1:264] 61 32 61 23 14 20 24 45 16 53 ...
##  $ Recep-ExcPorc         : num [1:264] 0.61 0.4 0.67 0.26 0.21 0.41 0.23 0.51 0.22 0.63 ...
##  $ Recep-Efic            : num [1:264] 0.52 0.36 0.65 0.19 0.01 0.39 0.11 0.44 0.14 0.51 ...
##  $ Ataque-Tot            : num [1:264] 182 134 155 136 98 98 147 169 106 137 ...
##  $ Ataque-Err            : num [1:264] 10 8 19 8 19 7 20 15 10 14 ...
##  $ Ataque-Blo            : num [1:264] 9 8 8 13 2 10 17 17 8 11 ...
##  $ Ataque-Exc            : num [1:264] 54 53 58 43 24 47 44 57 35 43 ...
##  $ Ataque-ExcPorc        : num [1:264] 0.3 0.4 0.37 0.32 0.24 0.48 0.3 0.34 0.33 0.31 ...
##  $ Ataque-Efic           : num [1:264] 0.19 0.28 0.2 0.16 0.03 0.31 0.05 0.15 0.16 0.13 ...
##  $ Bloqueo-Red           : num [1:264] 0 0 0 0 0 0 0 0 0 0 ...
##  $ Bloqueo-Pts           : num [1:264] 11 12 14 9 1 5 12 14 5 9 ...
```

```
##  $ Bloqueo-Puntos por set: num [1:264] 2.2 3 2.8 2.3 0.3 1.7 2.4 2.8 1.7 2.3 ...
##  $ Ganado/Perdido        : Factor w/ 2 levels "0","1": 1 2 1 1 1 2 1 1 1 1 ...
```

```
dim(partidos2021)
```

```
## [1] 264  27
```

```
summary(partidos2021)
```

```
##     Equipo           Sets jugados        Tot              BP
##  Length:264         Min.   :3.000   Min.   :24.00   Min.   : 5.00
##  Class :character   1st Qu.:3.000   1st Qu.:51.75   1st Qu.:19.00
##  Mode  :character   Median :4.000   Median :60.00   Median :26.00
##                     Mean   :3.818   Mean   :60.40   Mean   :24.85
##                     3rd Qu.:4.250   3rd Qu.:73.00   3rd Qu.:31.00
##                     Max.   :5.000   Max.   :92.00   Max.   :44.00
##        G              G-P           Saque-Tot        Saque-Pts
##  Min.   :16.00   Min.   :-10.00   Min.   : 42.00   Min.   : 0.00
##  1st Qu.:28.00   1st Qu.: 17.00   1st Qu.: 73.00   1st Qu.: 3.00
##  Median :35.00   Median : 30.00   Median : 82.00   Median : 4.00
##  Mean   :35.55   Mean   : 26.35   Mean   : 83.02   Mean   : 4.75
##  3rd Qu.:42.00   3rd Qu.: 37.00   3rd Qu.: 98.00   3rd Qu.: 6.00
##  Max.   :63.00   Max.   : 57.00   Max.   :117.00   Max.   :13.00
##    Saque-Err      Saque-Pts por set   Saque-Efic       Recep-Tot
##  Min.   : 0.000   Min.   :0.00      Min.   :-0.170   Min.   : 37.00
##  1st Qu.: 6.000   1st Qu.:0.80      1st Qu.:-0.090   1st Qu.: 62.75
##  Median : 8.000   Median :1.10      Median :-0.045   Median : 73.50
##  Mean   : 8.746   Mean   :1.27      Mean   :-0.050   Mean   : 74.24
##  3rd Qu.:11.000   3rd Qu.:1.70      3rd Qu.:-0.020   3rd Qu.: 88.25
##  Max.   :20.000   Max.   :4.30      Max.   : 0.100   Max.   :108.00
##    Recep-Err        Recep-Neg       Recep-Exc     Recep-ExcPorc
##  Min.   : 0.000   Min.   : 3.00   Min.   : 5.00   Min.   :0.0800
##  1st Qu.: 3.000   1st Qu.:15.00   1st Qu.:20.00   1st Qu.:0.3000
##  Median : 4.000   Median :21.00   Median :26.00   Median :0.3650
##  Mean   : 4.742   Mean   :21.28   Mean   :28.45   Mean   :0.3849
##  3rd Qu.: 6.000   3rd Qu.:27.00   3rd Qu.:34.00   3rd Qu.:0.4700
##  Max.   :13.000   Max.   :47.00   Max.   :63.00   Max.   :0.7100
##    Recep-Efic      Ataque-Tot      Ataque-Err      Ataque-Blo
##  Min.   :0.000   Min.   : 73.0   Min.   : 1.00   Min.   : 1.000
##  1st Qu.:0.240   1st Qu.:104.0   1st Qu.: 8.00   1st Qu.: 6.750
##  Median :0.305   Median :126.5   Median :11.00   Median : 9.000
##  Mean   :0.321   Mean   :130.0   Mean   :11.44   Mean   : 9.129
##  3rd Qu.:0.400   3rd Qu.:155.0   3rd Qu.:15.00   3rd Qu.:11.000
##  Max.   :0.670   Max.   :214.0   Max.   :24.00   Max.   :26.000
##    Ataque-Exc    Ataque-ExcPorc    Ataque-Efic      Bloqueo-Red
##  Min.   :22.00   Min.   :0.2200   Min.   :0.0000   Min.   :0.00000
##  1st Qu.:38.00   1st Qu.:0.3200   1st Qu.:0.1500   1st Qu.:0.00000
##  Median :45.00   Median :0.3600   Median :0.2000   Median :0.00000
##  Mean   :46.53   Mean   :0.3617   Mean   :0.2029   Mean   :0.02652
##  3rd Qu.:56.00   3rd Qu.:0.4000   3rd Qu.:0.2525   3rd Qu.:0.00000
##  Max.   :74.00   Max.   :0.5500   Max.   :0.4300   Max.   :2.00000
##   Bloqueo-Pts     Bloqueo-Puntos por set Ganado/Perdido
##  Min.   : 1.000   Min.   :0.30           0:133
```

```
##  1st Qu.: 6.750   1st Qu.:1.80          1:131
##  Median : 9.000   Median :2.30
##  Mean   : 9.125   Mean   :2.42
##  3rd Qu.:11.000   3rd Qu.:3.00
##  Max.   :26.000   Max.   :5.70
```

Estudio de las variables

Finalmente, tenemos una base de datos con las estadísticas correspondientes a los partidos de la fase regular en los que participaron los 12 equipos de la liga. Está compuesta por 264 registros con 27 variables. Las variables con las que se ha trabajado en este estudio son las siguientes:

- Variables cuantitativas discretas
  - Sets jugados
  - Tot (puntos totales ganados en el partido)
  - BP
  - G
  - G-P
  - Saque-Tot
  - Saque-Pts
  - Saque-Err
  - Recep-Tot
  - Recep-Err
  - Recep-Neg
  - Recep-Exc
  - Ataque-Tot
  - Ataque-Err
  - Ataque-Blo
  - Ataque-Exc
  - Bloqueo-Red
  - Bloqueo-Pts
- Variables cuantitativas continuas
  - Saque-Pts por set
  - Saque-Efic
  - Recep-Exc%: porcentaje de recepciones perfectas con respecto al total.
  - Recep-Efic: diferencia entre el número de recepciones perfectas y el número de recepciones falladas con respecto al total de recepciones en porcentaje.
  - Ataque-Exc%: porcentaje de ataques perfectos.
  - Ataque-Efic: diferencia entre el número de ataques perfectos y el número de ataques fallados y bloqueados con respecto al total de recepciones en porcentaje.
  - Bloqueo-Pts por set
- Variables cualitativas discretas
  - Equipo
  - Ganado/Perdido

VARIABLES SELECCIONADAS

```
dat = partidos2021[,c(1:2,4:5,7:9,12:15,18:21,24:25,27)]
str(dat)
```

```
## tibble [264 x 18] (S3: tbl_df/tbl/data.frame)
##  $ Equipo        : chr [1:264] "Cajasol Juvasa" "Cajasol Juvasa" "Cajasol Juvasa" "Cajasol Juvasa" .
##  $ Sets jugados  : num [1:264] 5 4 5 4 3 3 5 5 3 4 ...
##  $ BP            : num [1:264] 27 29 37 22 11 40 25 33 10 25 ...
##  $ G             : num [1:264] 44 39 42 36 16 24 39 42 32 34 ...
##  $ Saque-Tot     : num [1:264] 107 95 102 89 42 74 81 100 50 82 ...
##  $ Saque-Pts     : num [1:264] 6 3 7 6 2 12 8 4 2 7 ...
##  $ Saque-Err     : num [1:264] 13 9 11 11 3 9 7 14 7 14 ...
##  $ Recep-Tot     : num [1:264] 100 80 91 89 67 49 104 89 74 84 ...
##  $ Recep-Err     : num [1:264] 9 3 2 6 13 1 13 6 6 10 ...
##  $ Recep-Neg     : num [1:264] 17 34 13 29 12 13 47 24 36 10 ...
##  $ Recep-Exc     : num [1:264] 61 32 61 23 14 20 24 45 16 53 ...
##  $ Ataque-Tot    : num [1:264] 182 134 155 136 98 98 147 169 106 137 ...
##  $ Ataque-Err    : num [1:264] 10 8 19 8 19 7 20 15 10 14 ...
##  $ Ataque-Blo    : num [1:264] 9 8 8 13 2 10 17 17 8 11 ...
##  $ Ataque-Exc    : num [1:264] 54 53 58 43 24 47 44 57 35 43 ...
##  $ Bloqueo-Red   : num [1:264] 0 0 0 0 0 0 0 0 0 0 ...
##  $ Bloqueo-Pts   : num [1:264] 11 12 14 9 1 5 12 14 5 9 ...
##  $ Ganado/Perdido: Factor w/ 2 levels "0","1": 1 2 1 1 1 2 1 1 1 1 ...
```

Gráficos y análisis de las variables

```
library(ggplot2)
library(dplyr)
```

Boxplot

```
##
## 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(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v tibble  3.1.5     v purrr   0.3.4
## v tidyr   1.1.4     v stringr 1.4.0
## v readr   2.0.2     v forcats 0.5.1
```

```
## -- Conflicts ---------------------------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

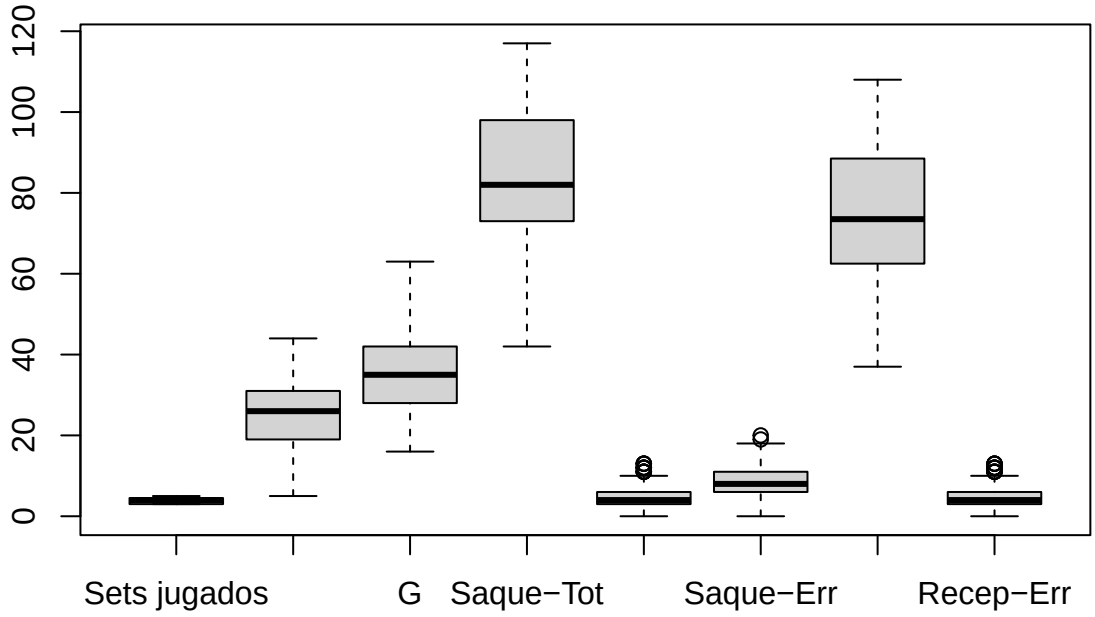
```
# CAMBIAMOS A FORMATO LARGO PARA HACER BOXPLOT DE LAS VARIABLES
partidos_boxplot1 = dat[,c(2:9)] %>%
  pivot_longer(names_to = "Variables",
               values_to = "Valores", cols=everything())
head(partidos_boxplot1)
```

```
## # A tibble: 6 x 2
##   Variables    Valores
##   <chr>          <dbl>
## 1 Sets jugados       5
## 2 BP                27
## 3 G                 44
## 4 Saque-Tot        107
## 5 Saque-Pts          6
## 6 Saque-Err         13
```

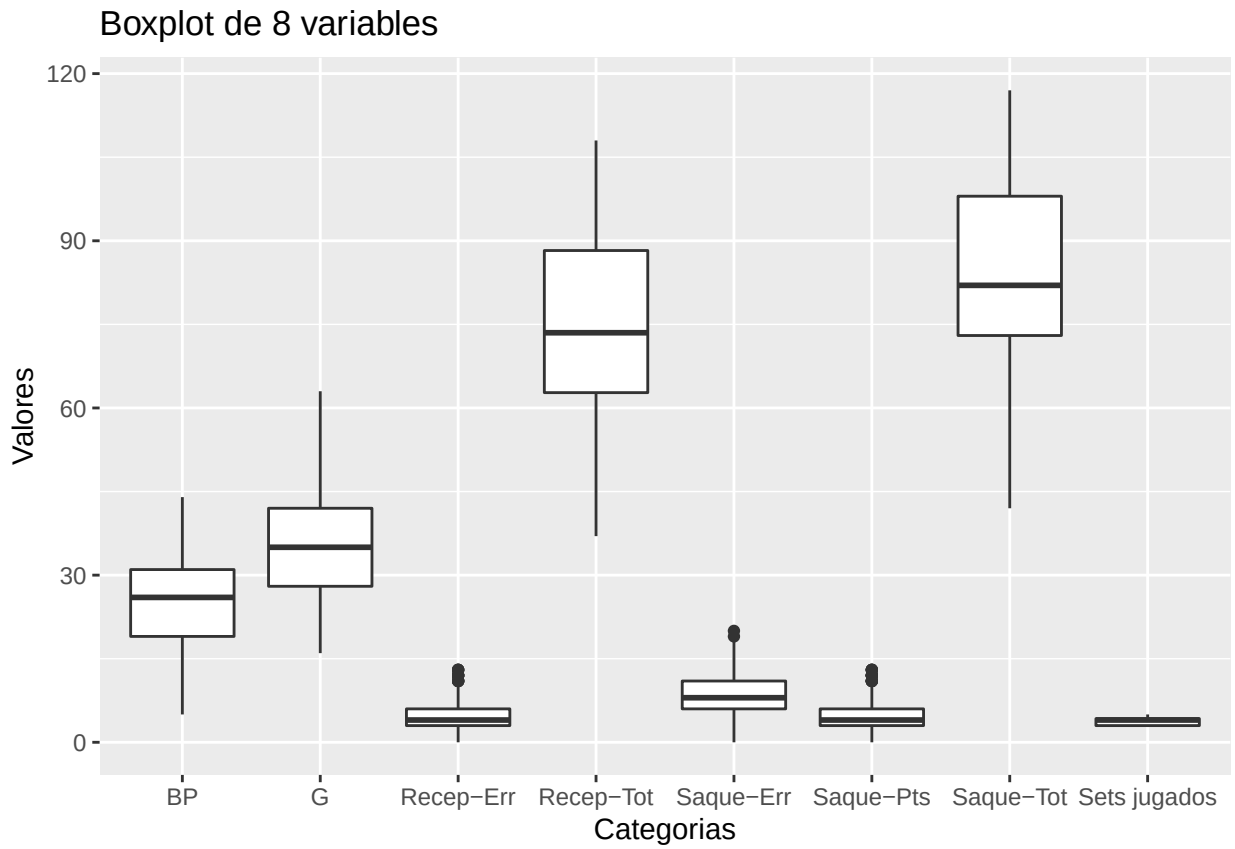
```
partidos_boxplot2 = dat[,c(10:17)] %>%
  pivot_longer(names_to = "Variables",
               values_to = "Valores", cols=everything())
head(partidos_boxplot2)
```

```
## # A tibble: 6 x 2
##   Variables  Valores
##   <chr>        <dbl>
## 1 Recep-Neg       17
## 2 Recep-Exc       61
## 3 Ataque-Tot     182
## 4 Ataque-Err      10
## 5 Ataque-Blo       9
## 6 Ataque-Exc      54
```

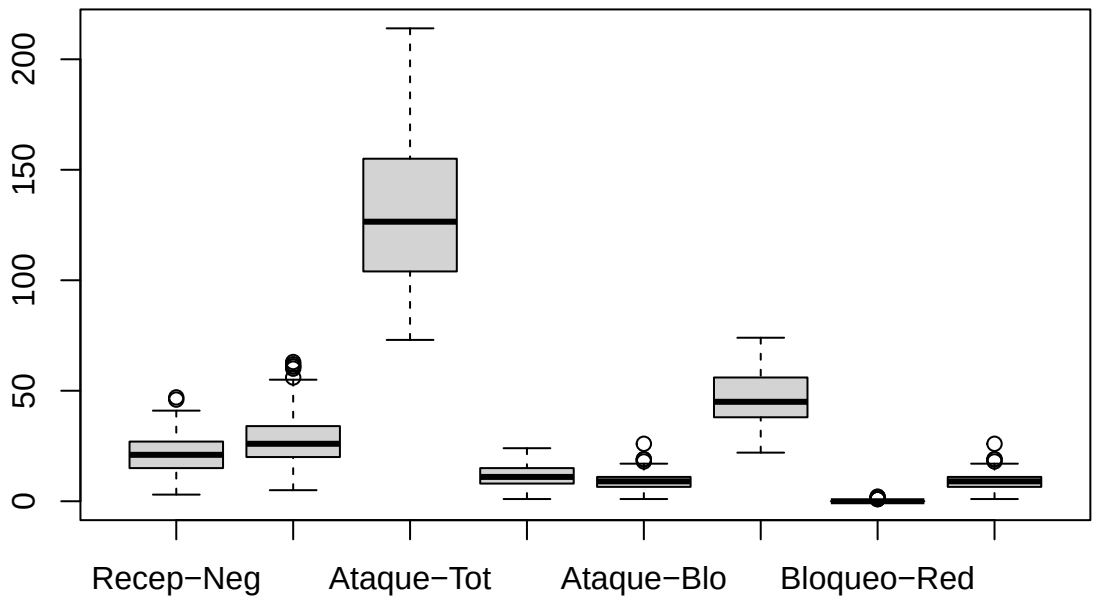
```
boxplot(dat[,2:9])
```



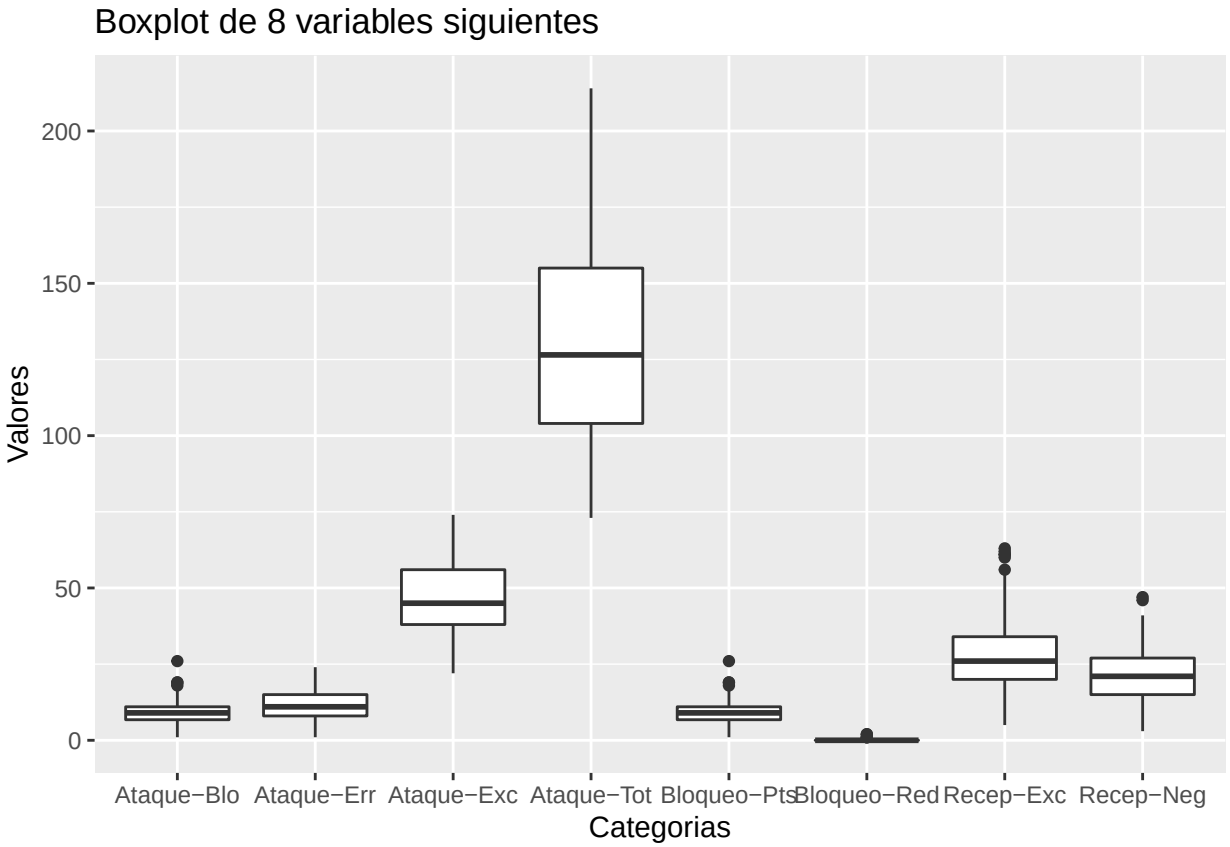

```
partidos_boxplot1 %>%
  ggplot(aes(x=`Variables` , y=Valores)) +
  geom_boxplot() +
  labs(
    title="Boxplot de 8 variables",
    x="Categorias",
    y="Valores")
```



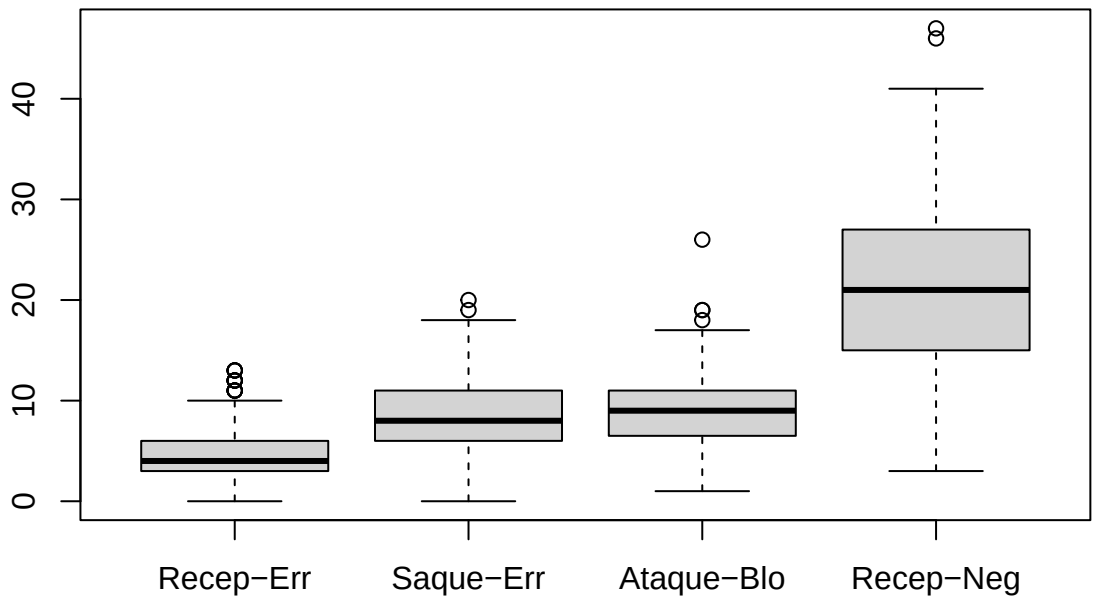

```
boxplot(dat[,10:17])
```



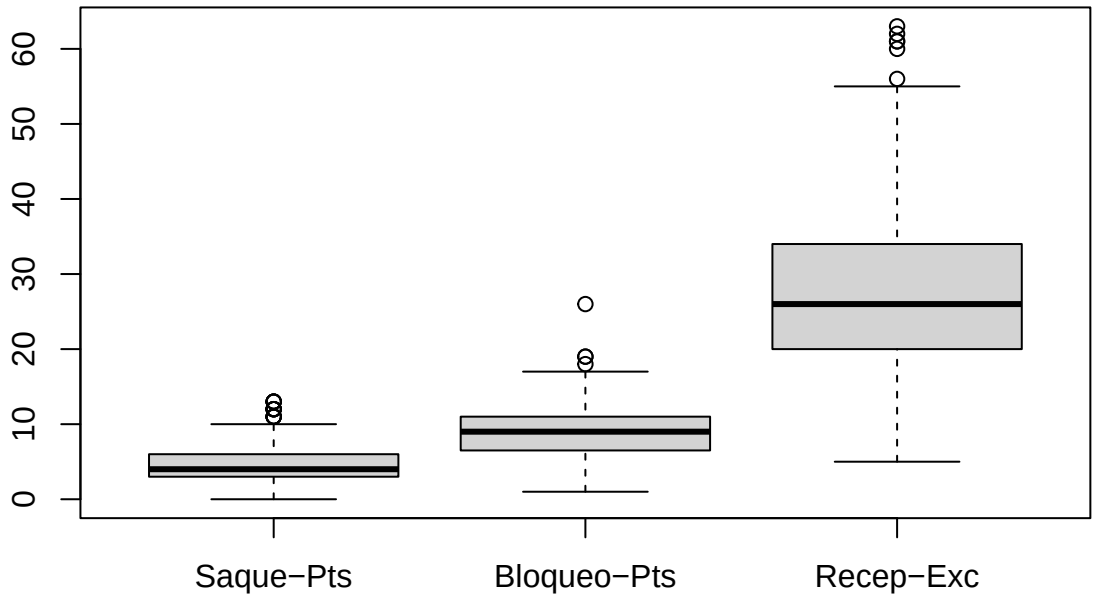

```
partidos_boxplot2 %>%
  ggplot(aes(x=Variables , y=Valores)) +
  geom_boxplot() +
  labs(
    title="Boxplot de 8 variables siguientes",
    x="Categorias",
    y="Valores")
```




```
boxplot(dat[c("Recep-Err","Saque-Err", "Ataque-Blo" ,"Recep-Neg")])
```




```
boxplot(dat[c("Saque-Pts","Bloqueo-Pts","Recep-Exc")])
```



Para ambos análisis podemos encontrar variables que presentan valores 'outliers', los cuales podrían afectar a nuestro estudio.

Matriz varianzas y correlaciones Analizamos ahora la matriz de varianzas/covarianzas y la matriz de correlaciones para ver qué variables pueden verse afectadas por los valores de otras.

```
var(dat[,c(2:17)])
```

```
##              Sets jugados          BP           G   Saque-Tot   Saque-Pts
## Sets jugados   0.65122710   3.27341860   6.1192534  12.9989630  0.54372624
## BP             3.27341860  65.66250432  30.3780245 113.1505358 14.01615970
## G              6.11925337  30.37802454  86.1800755 141.4327111  3.84505703
## Saque-Tot     12.99896301 113.15053578 141.4327111 340.5549026 20.19011407
## Saque-Pts      0.54372624  14.01615970   3.8450570  20.1901141  7.56463878
## Saque-Err      1.31489803   6.62016073  15.3414420  27.6122249  1.52186312
## Recep-Tot     11.70203941  18.57587280 126.5773707 200.7567692  0.01520913
## Recep-Err      0.55375043  -3.12184583   2.0925798   1.3879479 -0.78707224
## Recep-Neg      2.94400277  -5.28218977  27.2581951  35.2581519 -1.63403042
## Recep-Exc      5.59557553  27.10106291  61.1849435 115.5026501  5.21958175
## Ataque-Tot    20.90183201 105.16786208 234.7621702 445.3877751 10.97433460
## Ataque-Err     1.74179053   1.55565157  17.5828436  25.3773476 -0.78326996
## Ataque-Blo     1.23263049   0.46776702  12.1875504  17.9067865 -0.02091255
## Ataque-Exc     7.60559972  65.05526270  98.3180810 196.9273534  8.50855513
## Bloqueo-Red   -0.01797442  -0.09112513  -0.2351509  -0.3578177 -0.01235741
## Bloqueo-Pts    1.24334601  16.96910646  14.3949620  37.4657795  1.78802281
```

```
##                Saque-Err    Recep-Tot   Recep-Err  Recep-Neg   Recep-Exc
## Sets jugados  1.31489803  11.70203941  0.55375043  2.9440028   5.5955755
## BP            6.62016073  18.57587280 -3.12184583 -5.2821898  27.1010629
## G            15.34144199 126.57737066  2.09257979 27.2581951  61.1849435
## Saque-Tot    27.61222491 200.75676921  1.38794792 35.2581519 115.5026501
## Saque-Pts     1.52186312   0.01520913 -0.78707224 -1.6340304   5.2195817
## Saque-Err    13.41443427  25.17962899  1.21955294  6.8955381  13.1642614
## Recep-Tot    25.17962899 299.49994239 18.89918193 88.2026731 113.3808042
## Recep-Err     1.21955294  18.89918193  7.59880171  7.2273879   4.4131236
## Recep-Neg     6.89553808  88.20267312  7.22738795 68.9460623   1.7380027
## Recep-Exc    13.16426144 113.38080424  4.41312363  1.7380027 127.6553606
## Ataque-Tot   34.24811326 448.86599839 10.58272842 93.2955266 214.6674876
## Ataque-Err    1.18418021  49.39877866  1.52045166 13.6575066  15.9456735
## Ataque-Blo    2.15448208  35.28424934  1.79755732 12.0859258  12.8732861
## Ataque-Exc   18.32424530 129.11141837 -0.30112916 19.6409293  73.6438962
## Bloqueo-Red  -0.08069766  -0.59200369 -0.05778315 -0.1556487  -0.3427958
## Bloqueo-Pts   2.11549430  16.02661597  0.05893536  3.9691065   9.4225285
##                Ataque-Tot Ataque-Err  Ataque-Blo  Ataque-Exc Bloqueo-Red
## Sets jugados  20.9018320  1.7417905  1.23263049   7.6055997 -0.01797442
## BP           105.1678621  1.5556516  0.46776702  65.0552627 -0.09112513
## G            234.7621702 17.5828436 12.18755041  98.3180810 -0.23515094
## Saque-Tot    445.3877751 25.3773476 17.90678650 196.9273534 -0.35781772
## Saque-Pts     10.9743346 -0.7832700 -0.02091255   8.5085551 -0.01235741
## Saque-Err     34.2481133  1.1841802  2.15448208  18.3242453 -0.08069766
## Recep-Tot    448.8659984 49.3987787 35.28424934 129.1114184 -0.59200369
## Recep-Err     10.5827284  1.5204517  1.79755732  -0.3011292 -0.05778315
## Recep-Neg     93.2955266 13.6575066 12.08592580  19.6409293 -0.15564869
## Recep-Exc    214.6674876 15.9456735 12.87328609  73.6438962 -0.34279583
## Ataque-Tot   974.1939019 87.8348312 52.72194377 293.1919144 -0.78337078
## Ataque-Err    87.8348312 20.5514460  4.64281599  18.8590275 -0.10675193
## Ataque-Blo    52.7219438  4.6428160 13.75521373  12.1448612 -0.03764835
## Ataque-Exc   293.1919144 18.8590275 12.14486116 138.9650737 -0.28397569
## Bloqueo-Red   -0.7833708 -0.1067519 -0.03764835  -0.2839757  0.04111937
## Bloqueo-Pts   35.7637833  1.0627376  0.53136882  15.8997148 -0.02994297
##               Bloqueo-Pts
## Sets jugados  1.24334601
## BP           16.96910646
## G            14.39496198
## Saque-Tot    37.46577947
## Saque-Pts     1.78802281
## Saque-Err     2.11549430
## Recep-Tot    16.02661597
## Recep-Err     0.05893536
## Recep-Neg     3.96910646
## Recep-Exc     9.42252852
## Ataque-Tot   35.76378327
## Ataque-Err    1.06273764
## Ataque-Blo    0.53136882
## Ataque-Exc   15.89971483
## Bloqueo-Red  -0.02994297
## Bloqueo-Pts  13.67633080
```

```
cor = cor(dat[,2:17])
round(cor,3)
```

```
##              Sets jugados     BP      G Saque-Tot Saque-Pts Saque-Err Recep-Tot
## Sets jugados        1.000  0.501  0.817     0.873     0.245     0.445     0.838
## BP                  0.501  1.000  0.404     0.757     0.629     0.223     0.132
## G                   0.817  0.404  1.000     0.826     0.151     0.451     0.788
## Saque-Tot           0.873  0.757  0.826     1.000     0.398     0.409     0.629
## Saque-Pts           0.245  0.629  0.151     0.398     1.000     0.151     0.000
## Saque-Err           0.445  0.223  0.451     0.409     0.151     1.000     0.397
## Recep-Tot           0.838  0.132  0.788     0.629     0.000     0.397     1.000
## Recep-Err           0.249 -0.140  0.082     0.027    -0.104     0.121     0.396
## Recep-Neg           0.439 -0.079  0.354     0.230    -0.072     0.227     0.614
## Recep-Exc           0.614  0.296  0.583     0.554     0.168     0.318     0.580
## Ataque-Tot          0.830  0.416  0.810     0.773     0.128     0.300     0.831
## Ataque-Err          0.476  0.042  0.418     0.303    -0.063     0.071     0.630
## Ataque-Blo          0.412  0.016  0.354     0.262    -0.002     0.159     0.550
## Ataque-Exc          0.799  0.681  0.898     0.905     0.262     0.424     0.633
## Bloqueo-Red        -0.110 -0.055 -0.125    -0.096    -0.022    -0.109    -0.169
## Bloqueo-Pts         0.417  0.566  0.419     0.549     0.176     0.156     0.250
##              Recep-Err Recep-Neg Recep-Exc Ataque-Tot Ataque-Err Ataque-Blo
## Sets jugados     0.249     0.439     0.614      0.830      0.476      0.412
## BP              -0.140    -0.079     0.296      0.416      0.042      0.016
## G                0.082     0.354     0.583      0.810      0.418      0.354
## Saque-Tot        0.027     0.230     0.554      0.773      0.303      0.262
## Saque-Pts       -0.104    -0.072     0.168      0.128     -0.063     -0.002
## Saque-Err        0.121     0.227     0.318      0.300      0.071      0.159
## Recep-Tot        0.396     0.614     0.580      0.831      0.630      0.550
## Recep-Err        1.000     0.316     0.142      0.123      0.122      0.176
## Recep-Neg        0.316     1.000     0.019      0.360      0.363      0.392
## Recep-Exc        0.142     0.019     1.000      0.609      0.311      0.307
## Ataque-Tot       0.123     0.360     0.609      1.000      0.621      0.455
## Ataque-Err       0.122     0.363     0.311      0.621      1.000      0.276
## Ataque-Blo       0.176     0.392     0.307      0.455      0.276      1.000
## Ataque-Exc      -0.009     0.201     0.553      0.797      0.353      0.278
## Bloqueo-Red     -0.103    -0.092    -0.150     -0.124     -0.116     -0.050
## Bloqueo-Pts      0.006     0.129     0.226      0.310      0.063      0.039
##              Ataque-Exc Bloqueo-Red Bloqueo-Pts
## Sets jugados      0.799      -0.110       0.417
## BP                0.681      -0.055       0.566
## G                 0.898      -0.125       0.419
## Saque-Tot         0.905      -0.096       0.549
## Saque-Pts         0.262      -0.022       0.176
## Saque-Err         0.424      -0.109       0.156
## Recep-Tot         0.633      -0.169       0.250
## Recep-Err        -0.009      -0.103       0.006
## Recep-Neg         0.201      -0.092       0.129
## Recep-Exc         0.553      -0.150       0.226
## Ataque-Tot        0.797      -0.124       0.310
## Ataque-Err        0.353      -0.116       0.063
## Ataque-Blo        0.278      -0.050       0.039
## Ataque-Exc        1.000      -0.119       0.365
## Bloqueo-Red      -0.119       1.000      -0.040
## Bloqueo-Pts       0.365      -0.040       1.000
```

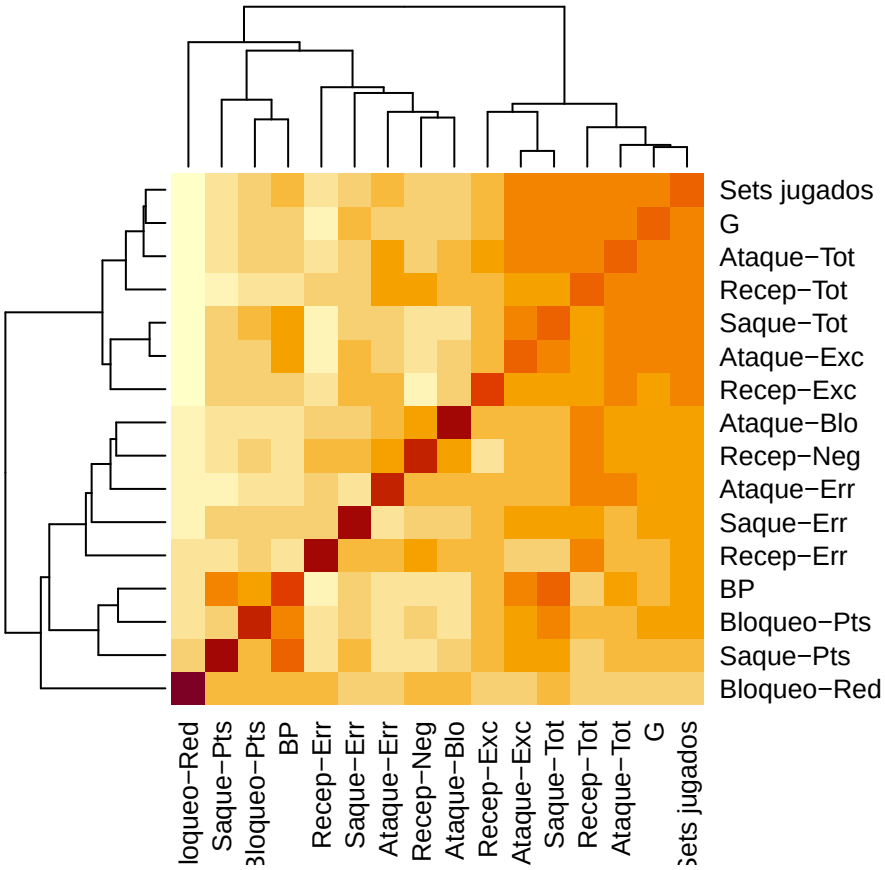
Para ver si hay variables explicativas que se encuentren muy correlacionadas realizamos el determinante de la matriz de correlaciones

```
det(cor)
```

```
## [1] 1.832815e-21
```

Tiene un valor muy próximo a cero luego eso significa que hay variables en las que existe una alta correlación entre ellas.

```
heatmap(cor)
```




```
# variables mas correlacionadas
variables = colnames(dat[,2:17])
correlacionMax=0.85
corAltas = matrix (ncol = 3)
cor[lower.tri(cor)] <- NA #pasamos a una matriz triangular superior para que no nos salgan pares repeti
for (i in 1:dim(cor)[1]){
    for (j in 1:dim(cor)[2]){
        if (is.na(cor[j,i]) && abs(cor[i,j])>correlacionMax && cor[i,j]<1){
          corAltas = rbind(corAltas, c(variables[i],variables[j],round(cor[i,j],4)))
        }
    }
}
(paresVariables = as.data.frame(corAltas[-1,]))
```

```
##             V1         V2     V3
```

V1	V2	V3
Sets jugados	Saque-Tot	0.8729
G	Ataque-Exc	0.8984
Saque-Tot	Ataque-Exc	0.9052

```
## 1 Sets jugados  Saque-Tot 0.8729
## 2            G Ataque-Exc 0.8984
## 3    Saque-Tot Ataque-Exc 0.9052
```

```
library(knitr)
library(kableExtra)
```

```
##
## Attaching package: 'kableExtra'
```

```
## The following object is masked from 'package:dplyr':
##
##     group_rows
```

```
kable(paresVariables, booktabs = T) %>% # , format = "latex"
kable_styling(latex_options = c( "scale_down"))
```

Esto puede indicar que existe un problema de multicolinealidad, en el que hay variables que me aportan información similar, luego esto puede dar lugar a interpretaciones erróneas. Para ello puede ser de gran ayuda un análisis de componentes principales.

Análisis de componentes principales

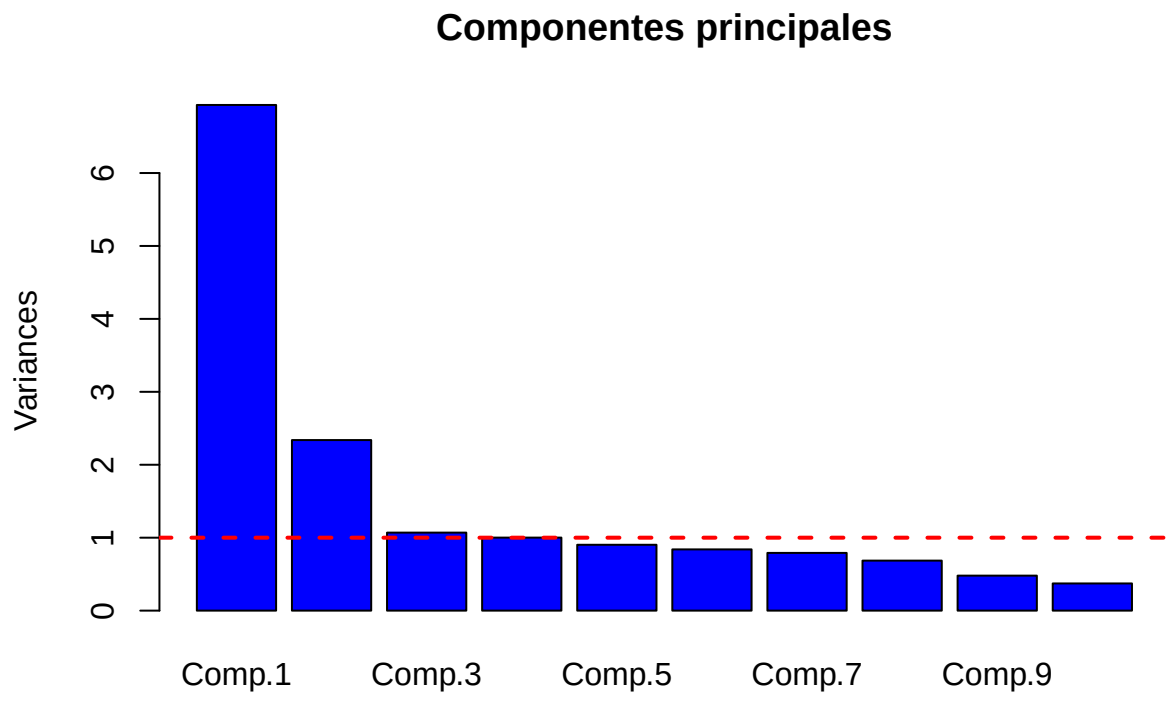
Objetivo central del Análisis de Comp. Principales (ACP): reducir la dimensión de un conjunto de datos, descritos por un número elevado de variables aleatorias interrelacionadas entre sí, reteniendo tanto como sea posible la variación que presenta dicho conjunto de datos. Se trata de explicar la estructura de varianzas y covarianzas del conjunto de variables a través de otro conjunto de variables, con un cardinal considerablemente menor que el primero. Así se podrá reducir dimensión, además de interpretar los datos

Su construcción no requiere supuesto de normalidad. No obstante, en poblaciones normales se pueden realizar tests de hipótesis y proporcionan interpretaciones útiles de los elipsoides de densidad constante.

```
cor =cor(dat[,2:17])
acp = princomp(dat[,2:17], cor=TRUE) #cor=TRUE variables tipificadas ya que las escalas son muy distint
summary(acp)
```

```
## Importance of components:
##                           Comp.1    Comp.2     Comp.3     Comp.4     Comp.5
## Standard deviation     2.6330709 1.5292513 1.03412326 1.00048441 0.95011628
## Proportion of Variance 0.4333164 0.1461631 0.06683818 0.06256057 0.05642006
## Cumulative Proportion  0.4333164 0.5794795 0.64631768 0.70887825 0.76529831
##                           Comp.6     Comp.7    Comp.8     Comp.9    Comp.10
## Standard deviation     0.9163127 0.88946338 0.8280396 0.69247868 0.61036833
## Proportion of Variance 0.0524768 0.04944657 0.0428531 0.02997042 0.02328434
## Cumulative Proportion  0.8177751 0.86722168 0.9100748 0.94004520 0.96332954
##                           Comp.11     Comp.12     Comp.13     Comp.14
## Standard deviation     0.47505349 0.394769481 0.350841574 0.208831622
## Proportion of Variance 0.01410474 0.009740184 0.007693113 0.002725665
## Cumulative Proportion  0.97743428 0.987174466 0.994867579 0.997593245
##                           Comp.15      Comp.16
## Standard deviation     0.196234768 2.980232e-08
## Proportion of Variance 0.002406755 5.551115e-17
## Cumulative Proportion  1.000000000 1.000000e+00
```

```
# grafico de sedimentacion
plot(acp, col="blue", main = "Componentes principales")
abline(h=mean(eigen(cor)$values), lwd=2,lty=2, col="red")
```




```
resumen<- matrix(NA,nrow=length(acp$sdev),ncol=3)
resumen[,1]<-  acp$sdev^2 # eigen(cor)$values
resumen[,2]<- 100*resumen[,1]/sum(resumen[,1])
```

```
resumen[,3]<- cumsum(resumen[,2])
colnames(resumen)<- c("Autovalor","Porcentaje",
                      "Porcentaje acumulado")
resumen
```

```
##          Autovalor   Porcentaje Porcentaje acumulado
##  [1,] 6.933063e+00 4.333164e+01             43.33164
##  [2,] 2.338610e+00 1.461631e+01             57.94795
##  [3,] 1.069411e+00 6.683818e+00             64.63177
##  [4,] 1.000969e+00 6.256057e+00             70.88782
##  [5,] 9.027209e-01 5.642006e+00             76.52983
##  [6,] 8.396289e-01 5.247680e+00             81.77751
##  [7,] 7.911451e-01 4.944657e+00             86.72217
##  [8,] 6.856496e-01 4.285310e+00             91.00748
##  [9,] 4.795267e-01 2.997042e+00             94.00452
## [10,] 3.725495e-01 2.328434e+00             96.33295
## [11,] 2.256758e-01 1.410474e+00             97.74343
## [12,] 1.558429e-01 9.740184e-01             98.71745
## [13,] 1.230898e-01 7.693113e-01             99.48676
## [14,] 4.361065e-02 2.725665e-01             99.75932
## [15,] 3.850808e-02 2.406755e-01            100.00000
## [16,] 8.881784e-16 5.551115e-15            100.00000
```

Hasta la 8 tenemos un 90% de la variabilidad explicada

Contraste de hipótesis para seleccionar el número de componentes principales (bajo hipótesis de normalidad multivariante)

```
apply(dat[,2:17],2 ,shapiro.test)
```

```
## $`Sets jugados`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.7787, p-value < 2.2e-16
##
##
## $BP
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.97866, p-value = 0.0005389
##
##
## $G
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.98404, p-value = 0.004777
##
```

```
##
## $`Saque-Tot`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.9659, p-value = 6.425e-06
##
##
## $`Saque-Pts`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.93232, p-value = 1.249e-09
##
##
## $`Saque-Err`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.98398, p-value = 0.004654
##
##
## $`Recep-Tot`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.97564, p-value = 0.0001732
##
##
## $`Recep-Err`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.93206, p-value = 1.182e-09
##
##
## $`Recep-Neg`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.98518, p-value = 0.00778
##
##
## $`Recep-Exc`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
```

```
## W = 0.94851, p-value = 5.077e-08
##
##
## $`Ataque-Tot`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.97049, p-value = 2.841e-05
##
##
## $`Ataque-Err`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.98592, p-value = 0.01075
##
##
## $`Ataque-Blo`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.97006, p-value = 2.464e-05
##
##
## $`Ataque-Exc`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.98453, p-value = 0.005889
##
##
## $`Bloqueo-Red`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.11135, p-value < 2.2e-16
##
##
## $`Bloqueo-Pts`
##
##  Shapiro-Wilk normality test
##
## data:  newX[, i]
## W = 0.96953, p-value = 2.064e-05
```

Se rechaza normalidad univariante para todas las variables a un nivel de signficación del 5%. No tenemos normalidad multivariante

Coeficientes y correlaciones de las C.P

```
loadings(acp)[,1:8] #Coeficientes que definen cada combinación lineal, si cogemos las 8 c.p
```

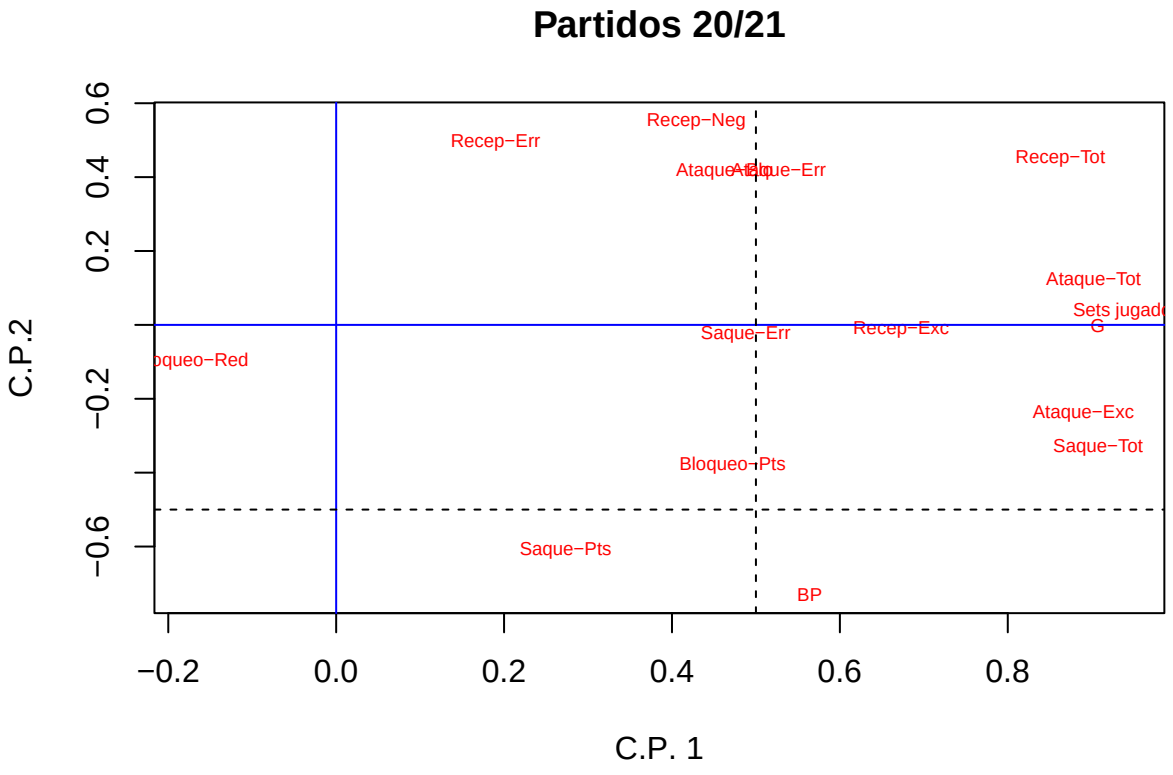
```
##                   Comp.1        Comp.2       Comp.3      Comp.4       Comp.5
## Sets jugados  0.35774470  0.0247191839  0.035099501  0.07115648  0.018271147
## BP            0.21420920 -0.4767896890  0.077446619  0.08382743 -0.153861184
## G             0.34448583 -0.0002557713 -0.087840721 -0.02410305  0.059721342
## Saque-Tot     0.34470264 -0.2164695925 -0.004166595  0.05769915 -0.032267696
## Saque-Pts     0.10378978 -0.3988844922  0.220525489  0.05903617  0.069092214
## Saque-Err     0.18529872 -0.0158136265  0.410706168 -0.04414134  0.542156394
## Recep-Tot     0.32764837  0.2948756395  0.008080708  0.02097984  0.002412539
## Recep-Err     0.07210912  0.3234375281  0.547437962  0.12650733  0.010648897
## Recep-Neg     0.16293727  0.3602875807  0.231732830  0.38869781 -0.239957361
## Recep-Exc     0.25560352 -0.0085519250 -0.088757744 -0.35340122  0.303480858
## Ataque-Tot    0.34267534  0.0794475648 -0.238348078 -0.06484705 -0.046217911
## Ataque-Err    0.20020777  0.2715302824 -0.373346355 -0.11960940 -0.299233793
## Ataque-Blo    0.17574665  0.2713896574 -0.071683919  0.12531401  0.181556320
## Ataque-Exc    0.33805666 -0.1568059060 -0.116601708 -0.07094215  0.069324669
## Bloqueo-Red  -0.06529745 -0.0646772648 -0.408478003  0.74405832  0.426865873
## Bloqueo-Pts   0.17932495 -0.2488665213  0.156868912  0.30540537 -0.459584969
##                   Comp.6       Comp.7       Comp.8
## Sets jugados  0.002729224  0.064382840  0.065722032
## BP            0.149930062  0.039544016  0.015958401
## G            -0.208766636 -0.091779858 -0.019687268
## Saque-Tot    -0.045207429  0.003966202  0.003879625
## Saque-Pts     0.674818087 -0.025931816  0.246345402
## Saque-Err    -0.295467413 -0.400623492  0.161007980
## Recep-Tot     0.003836983  0.036405892  0.040115350
## Recep-Err     0.047536649  0.629458485  0.169901691
## Recep-Neg     0.097582942 -0.399313537  0.093792758
## Recep-Exc    -0.014520163  0.420065573 -0.167162715
## Ataque-Tot    0.036563012  0.039798061  0.041694064
## Ataque-Err    0.130209271 -0.001276802  0.451747891
## Ataque-Blo    0.455831345 -0.115645027 -0.696516146
## Ataque-Exc   -0.103207654 -0.084242260  0.047233421
## Bloqueo-Red  -0.068814974  0.220038036  0.163568892
## Bloqueo-Pts  -0.368425435  0.144075199 -0.348227404
```

```
#para calcular las correlaciones entre las
#variables y las componentes
cor_vc<-loadings(acp)%*%diag(acp$sdev) #coeficientes*desvtipica
cor_vc[,1:8] # par las 8 comp. principales
```

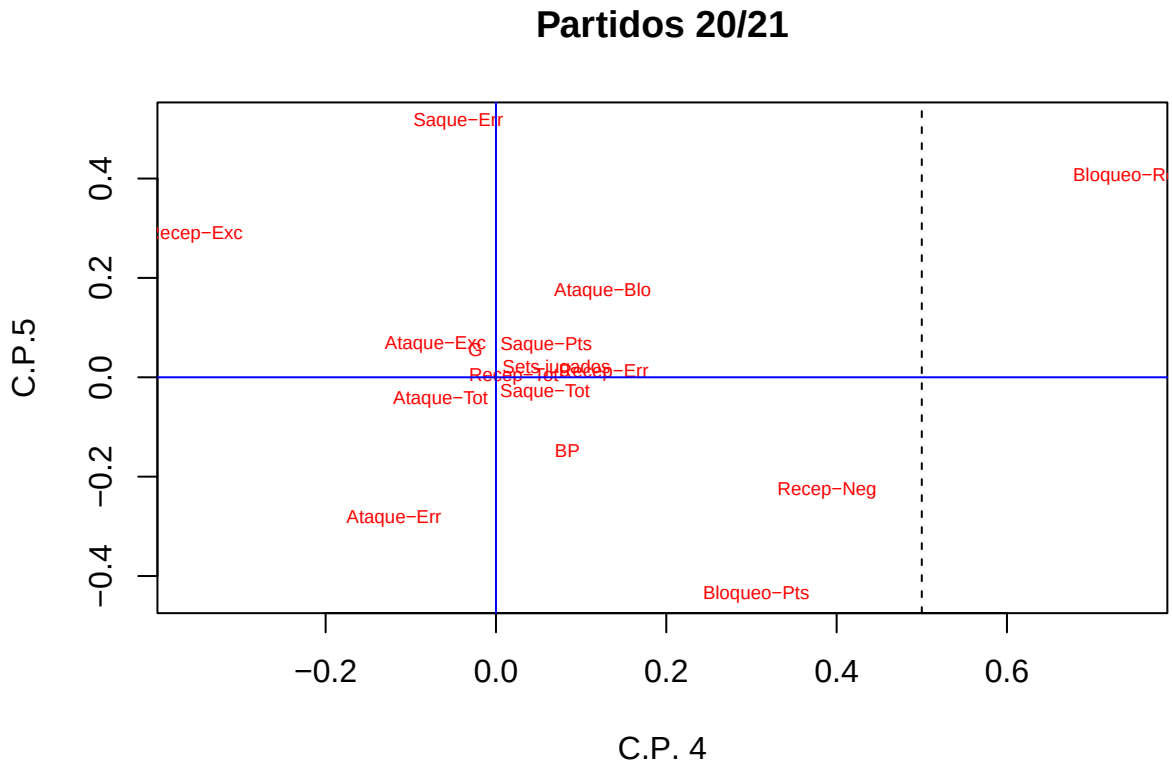
```
##                   [,1]          [,2]         [,3]        [,4]          [,5]
## Sets jugados  0.9419672  0.0378018439  0.036297211  0.07119095  0.017359714
## BP            0.5640280 -0.7291312478  0.080089350  0.08386804 -0.146186015
## G             0.9070556 -0.0003911385 -0.090838132 -0.02411472  0.056742219
## Saque-Tot     0.9076265 -0.3310364039 -0.004308773  0.05772710 -0.030658064
## Saque-Pts     0.2732859 -0.6099946251  0.228050537  0.05906476  0.065645638
## Saque-Err     0.4879047 -0.0241830087  0.424720801 -0.04416273  0.515111616
## Recep-Tot     0.8627214  0.4509389527  0.008356448  0.02099000  0.002292193
## Recep-Err     0.1898684  0.4946172577  0.566118329  0.12656861  0.010117690
## Recep-Neg     0.4290254  0.5509702483  0.239640309  0.38888610 -0.227987395
```

```
## Recep-Exc     0.6730222 -0.0130780424 -0.091786448 -0.35357241  0.288342104
## Ataque-Tot    0.9022885  0.1214952911 -0.246481291 -0.06487846 -0.043912390
## Ataque-Err    0.5271613  0.4152380352 -0.386086149 -0.11966734 -0.284306898
## Ataque-Blo    0.4627534  0.4150229842 -0.074130008  0.12537471  0.172499615
## Ataque-Exc    0.8901272 -0.2397956343 -0.120580539 -0.07097652  0.065866496
## Bloqueo-Red  -0.1719328 -0.0989077907 -0.422416604  0.74441875  0.405572215
## Bloqueo-Pts   0.4721753 -0.3805794492  0.162221790  0.30555332 -0.436659161
##                      [,6]         [,7]         [,8]
## Sets jugados  0.002500822  0.057266179  0.054420444
## BP            0.137382813  0.035172954  0.013214188
## G            -0.191295510 -0.081634822 -0.016301837
## Saque-Tot    -0.041424140  0.003527791  0.003212483
## Saque-Pts     0.618344352 -0.023065400  0.203983744
## Saque-Err    -0.270740529 -0.356339926  0.133320981
## Recep-Tot     0.003515876  0.032381707  0.033217097
## Recep-Err     0.043558433  0.559880271  0.140685325
## Recep-Neg     0.089416484 -0.355174768  0.077664116
## Recep-Exc    -0.013305009  0.373632944 -0.138417345
## Ataque-Tot    0.033503151  0.035398918  0.034524335
## Ataque-Err    0.119312403 -0.001135669  0.374065135
## Ataque-Blo    0.417684030 -0.102862017 -0.576742939
## Ataque-Exc   -0.094570480 -0.074930405  0.039111142
## Bloqueo-Red  -0.063056031  0.195715775  0.135441517
## Bloqueo-Pts  -0.337592888  0.128149613 -0.288346074
```

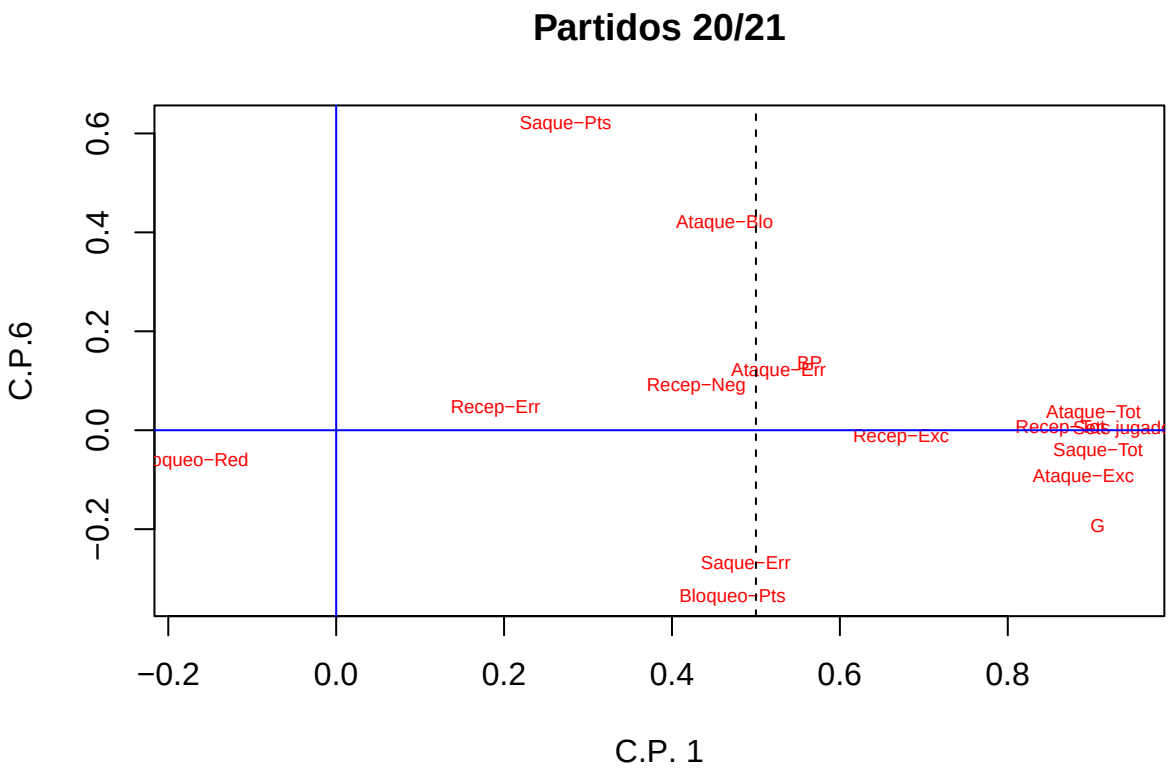
```
#Para ayudar a interpretar las CP:
plot(cor_vc[,1:2],type="n",
     main="Partidos 20/21",
     xlab="C.P. 1",ylab="C.P.2")
text(cor_vc[,1:2],labels=rownames(cor_vc),
     col="red",cex=0.6)
abline(h=0,v=0,lty=1,col="blue")
abline(v=0.5,lty=2)
abline(v=-0.5,lty=2)
abline(h=-0.5,lty=2)
```




```
#Para ayudar a interpretar las CP:
plot(cor_vc[,4:5],type="n",
     main="Partidos 20/21",
     xlab="C.P. 4",ylab="C.P.5")
text(cor_vc[,4:5],labels=rownames(cor_vc),
     col="red",cex=0.6)
abline(h=0,v=0,lty=1,col="blue")
abline(v=0.5,lty=2)
abline(v=-0.5,lty=2)
abline(h=-0.5,lty=2)
```




```
#Para ayudar a interpretar las CP:
plot(cor_vc[,c(1,6)],type="n",
     main="Partidos 20/21",
     xlab="C.P. 1",ylab="C.P.6")
text(cor_vc[,c(1,6)],labels=rownames(cor_vc),
     col="red",cex=0.6)
abline(h=0,v=0,lty=1,col="blue")
abline(v=0.5,lty=2)
abline(v=-0.5,lty=2)
abline(h=-0.5,lty=2)
```



No se pueden interpretar bien las componentes principales, luego no nos son útiles para el estudio.

Modelos estadísticos (con las variables seleccionadas)

Partición entrenamiento/test

```
n<- nrow(dat)
indin<- 1:n
nent<-ceiling(0.7*n)
ntest<- n-nent
set.seed(2468)
indient<- sort(sample(indin,nent))
inditest<- setdiff(indin,indient)
datent<- dat[indient,]
dattest<- dat[inditest,]

head(dattest,10)
```

```
## # A tibble: 10 x 18
##    Equipo         `Sets jugados`    BP     G `Saque-Tot` `Saque-Pts` `Saque-Err`
##    <chr>                   <dbl> <dbl> <dbl>       <dbl>       <dbl>       <dbl>
##  1 Cajasol Juvasa              3    15    33          62           2          10
##  2 AD Algar Surm~              5    31    50         107           4           9
##  3 AD Algar Surm~              5    28    40         108           4           8
```

```
##  4 AD Algar Surm~              4    19    47          96           5           6
##  5 AD Algar Surm~              4    16    40          80           4          15
##  6 AD Algar Surm~              4    26    40          89           7          12
##  7 AD Algar Surm~              4    25    36          86           2          10
##  8 AD Algar Surm~              3     9    26          56           4           4
##  9 Arenal Emevé                3    14    26          67           3           9
## 10 Arenal Emevé                5    29    55         101           6           9
## # ... with 11 more variables: Recep-Tot <dbl>, Recep-Err <dbl>,
## #   Recep-Neg <dbl>, Recep-Exc <dbl>, Ataque-Tot <dbl>, Ataque-Err <dbl>,
## #   Ataque-Blo <dbl>, Ataque-Exc <dbl>, Bloqueo-Red <dbl>, Bloqueo-Pts <dbl>,
## #   Ganado/Perdido <fct>
```

Regla simple de Bayes

```
library(e1071)
modeloNB<- naiveBayes(`Ganado/Perdido` ~ ., data = datent[,2:18])
modeloNB       # para cada variable, Media [,1] y s.d [,2] en cada categoria de la variable objetivo
```

```
##
## Naive Bayes Classifier for Discrete Predictors
##
## Call:
## naiveBayes.default(x = X, y = Y, laplace = laplace)
##
## A-priori probabilities:
## Y
##         0         1
## 0.4972973 0.5027027
##
## Conditional probabilities:
##    Sets jugados
## Y       [,1]      [,2]
##   0 3.782609 0.7959525
##   1 3.795699 0.8413129
##
##    BP
## Y       [,1]     [,2]
##   0 19.45652 7.319120
##   1 30.03226 5.057177
##
##    G
## Y       [,1]     [,2]
##   0 34.11957 9.402878
##   1 35.97849 9.323857
##
##    Saque-Tot
## Y       [,1]     [,2]
##   0 75.55435 19.39489
##   1 88.76344 15.00246
##
##    Saque-Pts
## Y       [,1]     [,2]
```

```
##   0 3.782609 2.479924
##   1 5.752688 2.958613
##
##    Saque-Err
## Y       [,1]     [,2]
##   0 9.076087 3.641138
##   1 8.752688 3.963573
##
##    Recep-Tot
## Y       [,1]     [,2]
##   0 79.77174 13.63101
##   1 66.79570 18.54639
##
##    Recep-Err
## Y       [,1]     [,2]
##   0 5.619565 2.732959
##   1 3.537634 2.139480
##
##    Recep-Neg
## Y       [,1]     [,2]
##   0 23.90217 8.180733
##   1 17.52688 7.033447
##
##    Recep-Exc
## Y       [,1]     [,2]
##   0 29.67391 11.77174
##   1 28.51613 11.87856
##
##    Ataque-Tot
## Y       [,1]     [,2]
##   0 129.4348 29.67676
##   1 127.2581 30.37659
##
##    Ataque-Err
## Y       [,1]     [,2]
##   0 12.50000 4.351329
##   1 10.04301 4.216721
##
##    Ataque-Blo
## Y        [,1]     [,2]
##   0 10.217391 3.893715
##   1  7.677419 3.284222
##
##    Ataque-Exc
## Y       [,1]     [,2]
##   0 41.78261 11.99526
##   1 50.22581 10.23541
##
##    Bloqueo-Red
## Y         [,1]      [,2]
##   0 0.02173913 0.2085144
##   1 0.02150538 0.1458479
##
##    Bloqueo-Pts
```

```
## Y       [,1]     [,2]
##   0  8.01087 3.242894
##   1 10.03226 3.971232
```

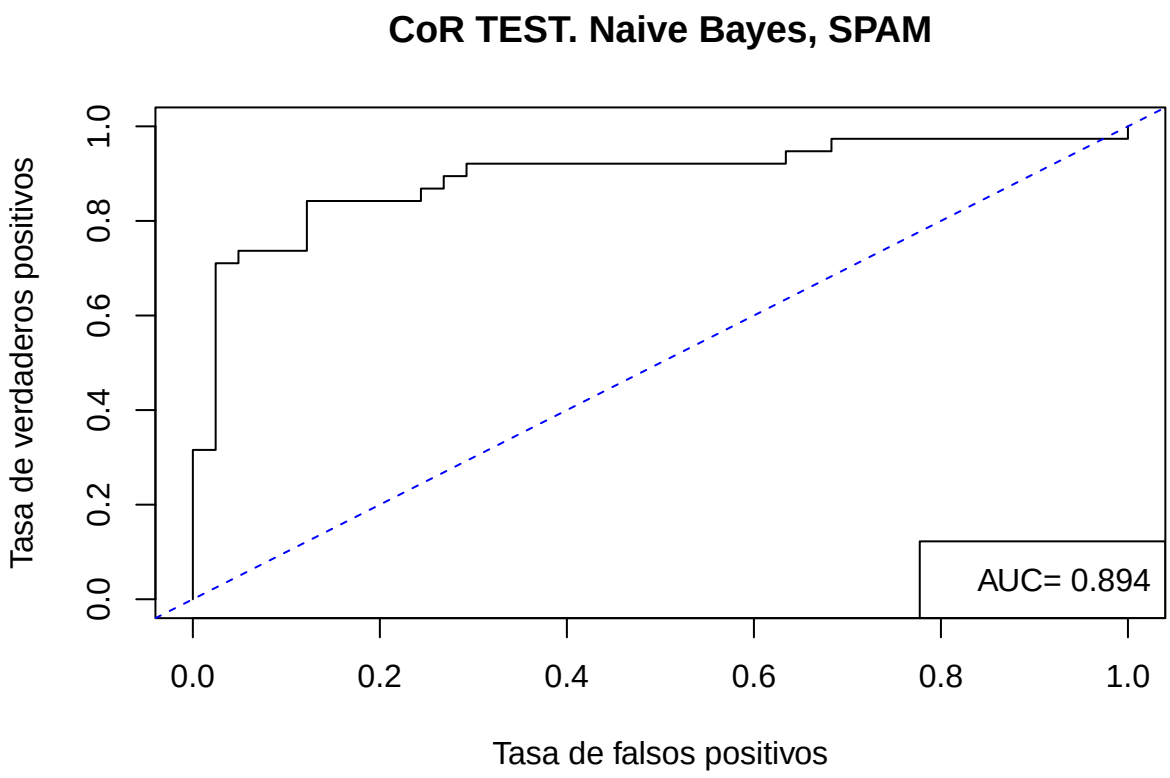
```
preditestNB<- predict(modeloNB,dattest)
confutestNB<-table(dattest$`Ganado/Perdido`,preditestNB)
confutestNB
```

```
##    preditestNB
##      0  1
##   0 35  6
##   1  6 32
```

```
AciertoNB=round(100*mean(dattest$`Ganado/Perdido`==preditestNB),2)
SensEspecNB=round(100*diag(prop.table(confutestNB,1)),2)
c(AciertoNB,SensEspecNB)
```

```
##           0     1
## 84.81 85.37 84.21
```

```
library(ROCR)
probabi1<- predict(modeloNB,dattest,
                   type="raw")[,2] #Prob. ganar partido
prediobj<-prediction(probabi1,dattest$`Ganado/Perdido`)
plot(performance(prediobj, "tpr","fpr"),
     main="CoR TEST. Naive Bayes, SPAM",
     xlab="Tasa de falsos positivos", ylab="Tasa de verdaderos positivos")
abline(a=0,b=1,col="blue",lty=2)
aucNB<- as.numeric(performance(prediobj,"auc")@y.values)
legend("bottomright",legend=paste("AUC=",round(aucNB,3)))
```



Guardamos resultados

```
Resul=c(Acierto=AciertoNB,AUC=aucNB,SensEspecNB)
Resul
```

```
##   Acierto       AUC         0         1
## 84.810000  0.894095 85.370000 84.210000
```

```
detach("package:e1071")
library(naivebayes)
```

Otra libreria

```
## naivebayes 0.9.7 loaded
```

```
modeloNB2<- naive_bayes(`Ganado/Perdido` ~ ., data = datent[,2:18],
                        usekernel=TRUE,kernel ="epanechnikov",bw="nrd0",
                        usepoisson=T)
# podemos hacerlo por equipos
# modeloNB2<- naive_bayes(`Ganado/Perdido` ~ ., data = datent,
#                         usekernel=TRUE,kernel ="epanechnikov",bw="nrd0",
#                         usepoisson=T)
```

```r
#usekernel=TRUE permite estimar la funcion de densidad
#mediante el metodo nucleo para variables numericas
#utilizando la funcion density, por defecto nucleo gaussiano
#y metodo nrd0 para estimar amplitud de ventana
#usepoisson=TRUE permite estimar la funcion de probabilidad
#mediante el ajuste de una ley Poisson para variables "integer"
#por defecto estimadores maxima verosimilitud ver help(naive_bayes)
#y el documento intro_naivebayes.pdf

summary(modeloNB2)
```

```
##
## ================================== Naive Bayes ==================================
##
## - Call: naive_bayes.formula(formula = `Ganado/Perdido` ~ ., data = datent[,      2:18], usekernel = T
## - Laplace: 0
## - Classes: 2
## - Samples: 185
## - Features: 16
## - Conditional distributions:
##     - KDE: 16
## - Prior probabilities:
##     - 0: 0.4973
##     - 1: 0.5027
##
## ---------------------------------------------------------------------------------
```

```r
modeloNB2
```

```
##
## ================================== Naive Bayes ==================================
##
##  Call:
## naive_bayes.formula(formula = `Ganado/Perdido` ~ ., data = datent[,
##     2:18], usekernel = TRUE, usepoisson = T, kernel = "epanechnikov",
##     bw = "nrd0")
##
## ---------------------------------------------------------------------------------
##
## Laplace smoothing: 0
##
## ---------------------------------------------------------------------------------
##
##  A priori probabilities:
##
##         0         1
## 0.4972973 0.5027027
##
## ---------------------------------------------------------------------------------
##
##  Tables:
##
```

```
## ------------------------------------------------------------------------------
##  ::: Sets jugados::0 (KDE)
## ------------------------------------------------------------------------------
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
##
## Data: x (92 obs.);   Bandwidth 'bw' = 0.2719
##
##        x               y
##  Min.   :2.184   Min.   :0.0000
##  1st Qu.:3.092   1st Qu.:0.1948
##  Median :4.000   Median :0.2773
##  Mean   :4.000   Mean   :0.2751
##  3rd Qu.:4.908   3rd Qu.:0.3855
##  Max.   :5.816   Max.   :0.5497
##
## ------------------------------------------------------------------------------
##  ::: Sets jugados::1 (KDE)
## ------------------------------------------------------------------------------
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
##
## Data: x (93 obs.);   Bandwidth 'bw' = 0.3058
##
##        x               y
##  Min.   :2.082   Min.   :0.0000
##  1st Qu.:3.041   1st Qu.:0.2148
##  Median :4.000   Median :0.2679
##  Mean   :4.000   Mean   :0.2605
##  3rd Qu.:4.959   3rd Qu.:0.3382
##  Max.   :5.918   Max.   :0.5188
##
## ------------------------------------------------------------------------------
##  ::: BP::0 (KDE)
## ------------------------------------------------------------------------------
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
##
## Data: x (92 obs.);   Bandwidth 'bw' = 2.667
##
##        x            y
##  Min.   :-3   Min.   :0.000000
##  1st Qu.: 9   1st Qu.:0.002517
##  Median :21   Median :0.017964
##  Mean   :21   Mean   :0.020811
##  3rd Qu.:33   3rd Qu.:0.035631
##  Max.   :45   Max.   :0.052230
##
## ------------------------------------------------------------------------------
##  ::: BP::1 (KDE)
## ------------------------------------------------------------------------------
```

```
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
##
## Data: x (93 obs.);   Bandwidth 'bw' = 1.838
##
##        x               y
##  Min.   :14.48   Min.   :0.00000
##  1st Qu.:23.24   1st Qu.:0.00289
##  Median :32.00   Median :0.02043
##  Mean   :32.00   Mean   :0.02852
##  3rd Qu.:40.76   3rd Qu.:0.05481
##  Max.   :49.52   Max.   :0.07147
##
## ------------------------------------------------------------------------------
##  ::: G::0 (KDE)
## ------------------------------------------------------------------------------
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
##
## Data: x (92 obs.);   Bandwidth 'bw' = 3.426
##
##        x                y
##  Min.   : 5.723   Min.   :0.000000
##  1st Qu.:21.111   1st Qu.:0.002274
##  Median :36.500   Median :0.013584
##  Mean   :36.500   Mean   :0.016228
##  3rd Qu.:51.889   3rd Qu.:0.031266
##  Max.   :67.277   Max.   :0.035294
##
## ------------------------------------------------------------------------------
##  ::: G::1 (KDE)
## ------------------------------------------------------------------------------
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
##
## Data: x (93 obs.);   Bandwidth 'bw' = 3.39
##
##        x                y
##  Min.   : 9.831   Min.   :0.000000
##  1st Qu.:24.916   1st Qu.:0.001844
##  Median :40.000   Median :0.015224
##  Mean   :40.000   Mean   :0.016558
##  3rd Qu.:55.084   3rd Qu.:0.031536
##  Max.   :70.169   Max.   :0.036955
##
## ------------------------------------------------------------------------------
##  ::: Saque-Tot::0 (KDE)
## ------------------------------------------------------------------------------
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
```

```
##
## Data: x (92 obs.);   Bandwidth 'bw' = 7.066
##
##        x               y
##  Min.   : 20.8   Min.   :0.000000
##  1st Qu.: 48.9   1st Qu.:0.001607
##  Median : 77.0   Median :0.010710
##  Mean   : 77.0   Mean   :0.008888
##  3rd Qu.:105.1   3rd Qu.:0.014545
##  Max.   :133.2   Max.   :0.017599
##
## ------------------------------------------------------------------------------
##  ::: Saque-Tot::1 (KDE)
## ------------------------------------------------------------------------------
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
##
## Data: x (93 obs.);   Bandwidth 'bw' = 5.454
##
##        x                y
##  Min.   : 56.64   Min.   :0.000000
##  1st Qu.: 75.32   1st Qu.:0.005492
##  Median : 94.00   Median :0.014447
##  Mean   : 94.00   Mean   :0.013370
##  3rd Qu.:112.68   3rd Qu.:0.019303
##  Max.   :131.36   Max.   :0.028897
##
## ------------------------------------------------------------------------------
##  ::: Saque-Pts::0 (KDE)
## ------------------------------------------------------------------------------
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
##
## Data: x (92 obs.);   Bandwidth 'bw' = 0.8156
##
##        x                y
##  Min.   :-2.447   Min.   :0.000000
##  1st Qu.: 2.027   1st Qu.:0.006214
##  Median : 6.500   Median :0.026357
##  Mean   : 6.500   Mean   :0.055830
##  3rd Qu.:10.973   3rd Qu.:0.092736
##  Max.   :15.447   Max.   :0.193579
##
## ------------------------------------------------------------------------------
##  ::: Saque-Pts::1 (KDE)
## ------------------------------------------------------------------------------
##
## Call:
##  density.default(x = x, bw = "nrd0", kernel = "epanechnikov",     na.rm = TRUE)
##
## Data: x (93 obs.);   Bandwidth 'bw' = 0.8139
##
```

```
##        x                y
##  Min.   :-2.442   Min.   :0.00000
##  1st Qu.: 2.029   1st Qu.:0.01717
##  Median : 6.500   Median :0.03767
##  Mean   : 6.500   Mean   :0.05586
##  3rd Qu.:10.971   3rd Qu.:0.09014
##  Max.   :15.442   Max.   :0.16595
##
## ------------------------------------------------------------------------------
##
## # ... and 11 more tables
##
## ------------------------------------------------------------------------------
```

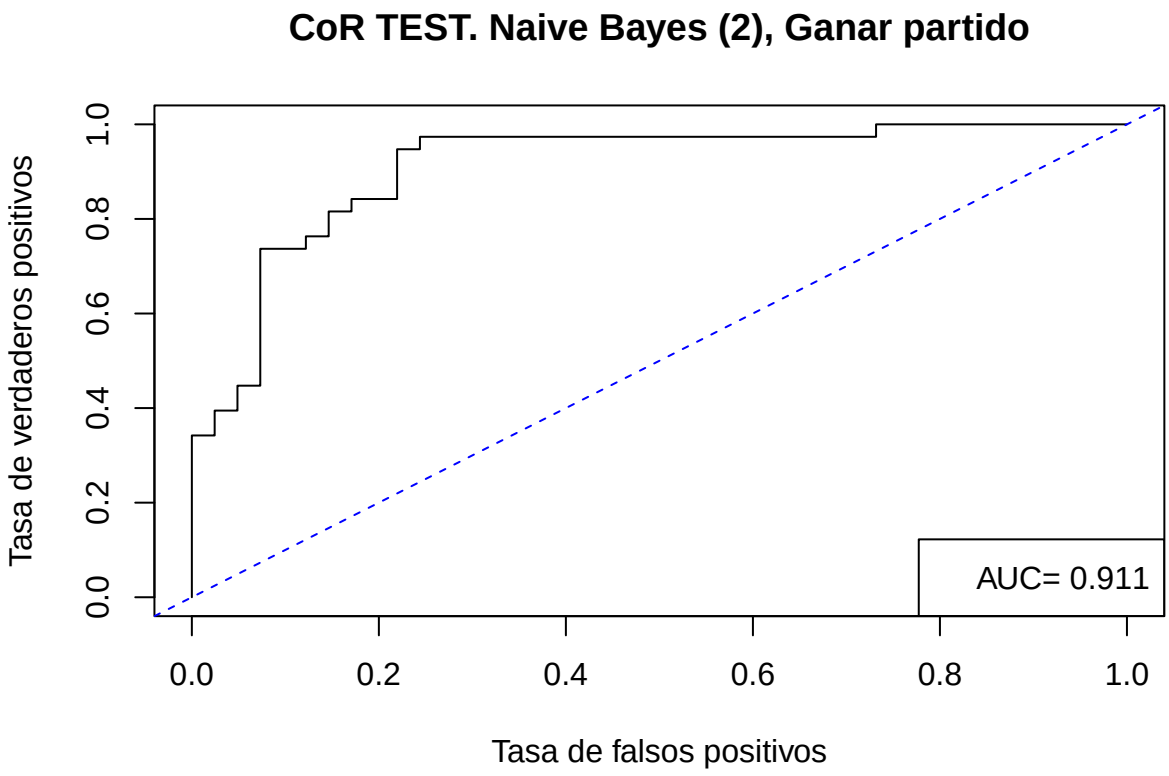
```
#Evaluar el rendimiento
preditestNB2<- predict(modeloNB2,dattest[,2:17])
confutestNB2<-table(dattest$`Ganado/Perdido`,preditestNB2)
confutestNB2
```

```
##    preditestNB2
##      0  1
##   0 32  9
##   1  6 32
```

```
AciertoNB2=round(100*mean(dattest$`Ganado/Perdido`==preditestNB2),2)
SensEspecNB2=round(100*diag(prop.table(confutestNB2,1)),2)
c(AciertoNB2, SensEspecNB2)
```

```
##           0     1
## 81.01 78.05 84.21
```

```
probabi2<- predict(modeloNB2,dattest[,2:17],
                   type="prob")[,2] #Prob. ganado
prediobj2<-prediction(probabi2,dattest$`Ganado/Perdido`)
plot(performance(prediobj2, "tpr","fpr"),
     main="CoR TEST. Naive Bayes (2), Ganar partido",
     xlab="Tasa de falsos positivos", ylab="Tasa de verdaderos positivos")
abline(a=0,b=1,col="blue",lty=2)
aucNB2<- as.numeric(performance(prediobj2,"auc")@y.values)
legend("bottomright",legend=paste("AUC=",round(aucNB2,3)))
```




```
Resul=rbind(Resul,c(AciertoNB2,aucNB2,SensEspecNB2))
rownames(Resul)=c("Gauss","Kernel(Poisson)")
Resul
```

```
##                 Acierto       AUC     0     1
## Gauss             84.81 0.8940950 85.37 84.21
## Kernel(Poisson)   81.01 0.9107831 78.05 84.21
```

Análisis discriminante lineal

```
library(MASS)
```

```
##
## Attaching package: 'MASS'
```

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

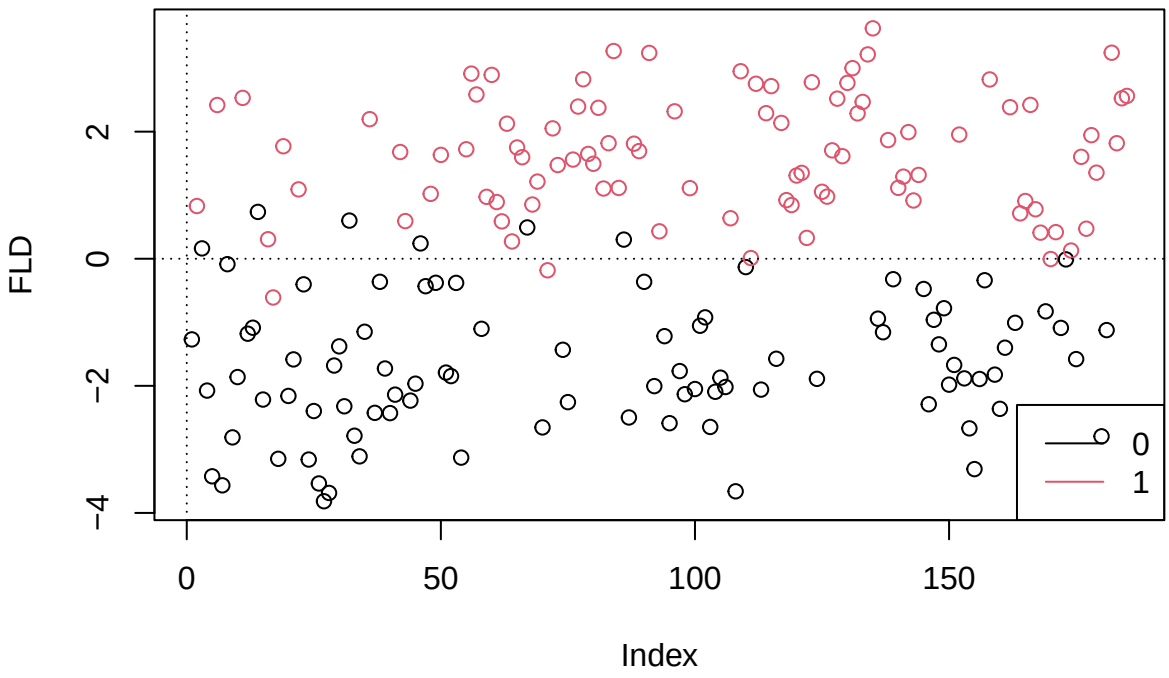
```
modeloLDA = lda(`Ganado/Perdido` ~. , datent[,2:18])
```

```
## Warning in lda.default(x, grouping, ...): variables are collinear
```

```
modeloLDA
```

```
## Call:
## lda(`Ganado/Perdido` ~ ., data = datent[, 2:18])
##
## Prior probabilities of groups:
##         0         1
## 0.4972973 0.5027027
##
## Group means:
##   `Sets jugados`       BP        G `Saque-Tot` `Saque-Pts` `Saque-Err`
## 0       3.782609 19.45652 34.11957    75.55435    3.782609    9.076087
## 1       3.795699 30.03226 35.97849    88.76344    5.752688    8.752688
##   `Recep-Tot` `Recep-Err` `Recep-Neg` `Recep-Exc` `Ataque-Tot` `Ataque-Err`
## 0    79.77174    5.619565    23.90217    29.67391     129.4348     12.50000
## 1    66.79570    3.537634    17.52688    28.51613     127.2581     10.04301
##   `Ataque-Blo` `Ataque-Exc` `Bloqueo-Red` `Bloqueo-Pts`
## 0    10.217391     41.78261    0.02173913       8.01087
## 1     7.677419     50.22581    0.02150538      10.03226
##
## Coefficients of linear discriminants:
##                          LD1
## `Sets jugados` -0.165283206
## BP              0.056292867
## G               0.054135326
## `Saque-Tot`     0.052078083
## `Saque-Pts`    -0.039623741
## `Saque-Err`    -0.038740936
## `Recep-Tot`    -0.122976427
## `Recep-Err`     0.034456888
## `Recep-Neg`     0.013940734
## `Recep-Exc`     0.001495282
## `Ataque-Tot`   -0.001017513
## `Ataque-Err`    0.011787154
## `Ataque-Blo`   -0.034964195
## `Ataque-Exc`    0.058993188
## `Bloqueo-Red`   0.550241207
## `Bloqueo-Pts`  -0.004794856
```

```
#Coeficientes FLD en cada caso:
FLD=predict(modeloLDA)$x
plot(FLD, col = datent[,18]$`Ganado/Perdido`)
abline(h=0,v=0,lty=3)
legend("bottomright",col=1:2,lty=1,
       legend=levels(datent$`Ganado/Perdido`))
```



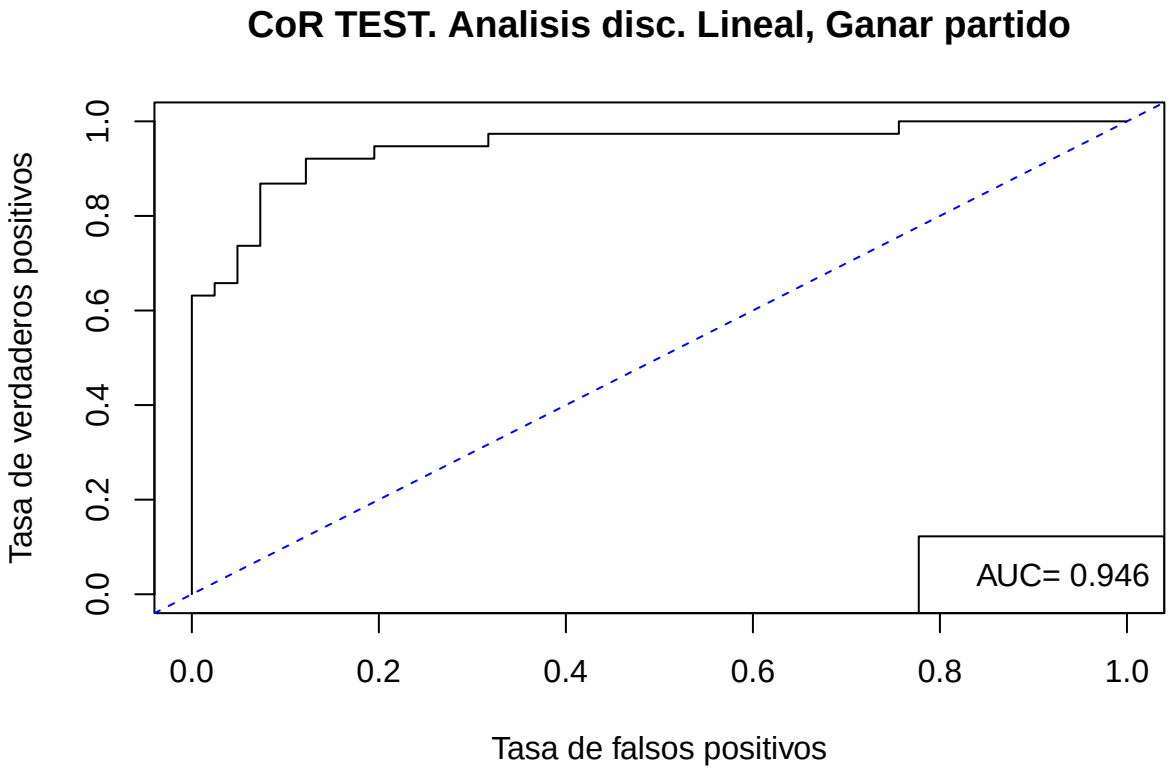

```
preditestLDA=predict(modeloLDA,newdata=dattest[,2:18])$class
confutestLDA=table(Real=dat[inditest,18]$`Ganado/Perdido`,Predic=preditestLDA)
confutestLDA
```

```
##     Predic
## Real  0  1
##    0 36  5
##    1  4 34
```

```
AciertoLDA=round(100*mean(dattest$`Ganado/Perdido`==preditestLDA),2)
SensEspecLDA=round(100*diag(prop.table(confutestLDA,1)),2)
c(AciertoLDA, SensEspecLDA)
```

```
##           0     1
## 88.61 87.80 89.47
```

```
probabiLDA<- predict(modeloLDA,dattest[,2:17],
                     type="prob")$posterior[,2] #Prob. ganado
prediobjLDA<-prediction(probabiLDA,dattest$`Ganado/Perdido`)
plot(performance(prediobjLDA, "tpr","fpr"),
     main="CoR TEST. Analisis disc. Lineal, Ganar partido",
     xlab="Tasa de falsos positivos", ylab="Tasa de verdaderos positivos")
abline(a=0,b=1,col="blue",lty=2)
aucLDA<- as.numeric(performance(prediobjLDA,"auc")@y.values)
legend("bottomright",legend=paste("AUC=",round(aucLDA,3)))
```




```
Resul=rbind(Resul,c(AciertoLDA,aucLDA,SensEspecLDA))
rownames(Resul)=c("Gauss","Kernel(Poisson)","LDA")
Resul
```

```
##                  Acierto       AUC     0     1
## Gauss              84.81 0.8940950 85.37 84.21
## Kernel(Poisson)    81.01 0.9107831 78.05 84.21
## LDA                88.61 0.9460847 87.80 89.47
```

Regresión Logística

```
modeloRL<- glm(`Ganado/Perdido`~.,family=binomial,data=datent[,2:18])
summary(modeloRL)
```

```
##
## Call:
## glm(formula = `Ganado/Perdido` ~ ., family = binomial, data = datent[,
##     2:18])
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -1.98108  -0.01116   0.00075   0.05491   2.78686
##
```

```
## Coefficients: (1 not defined because of singularities)
##                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -5.122602   4.580465  -1.118  0.26341
## `Sets jugados` -0.648016   2.230774  -0.290  0.77144
## BP              0.146225   0.172401   0.848  0.39634
## G               0.132572   0.240044   0.552  0.58075
## `Saque-Tot`     0.335767   0.160750   2.089  0.03673 *
## `Saque-Pts`    -0.120591   0.202100  -0.597  0.55072
## `Saque-Err`    -0.091613   0.151841  -0.603  0.54628
## `Recep-Tot`    -0.515526   0.198638  -2.595  0.00945 **
## `Recep-Err`    -0.106450   0.233017  -0.457  0.64779
## `Recep-Neg`     0.103785   0.106481   0.975  0.32972
## `Recep-Exc`     0.013582   0.067740   0.201  0.84109
## `Ataque-Tot`    0.004566   0.037070   0.123  0.90198
## `Ataque-Err`   -0.068466   0.175064  -0.391  0.69573
## `Ataque-Blo`   -0.314011   0.217515  -1.444  0.14884
## `Ataque-Exc`    0.228187   0.169631   1.345  0.17856
## `Bloqueo-Red`   4.328331  23.113715   0.187  0.85145
## `Bloqueo-Pts`         NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 256.459  on 184  degrees of freedom
## Residual deviance:  39.722  on 169  degrees of freedom
## AIC: 71.722
##
## Number of Fisher Scoring iterations: 9
```

Vemos que todos los coeficientes asociados a las variables (y el termino independiente) no son significativos al 5%, excepto las variables `Saque-Tot` (0.03686) y `Recep-Tot` (0.00955)

```
# Vamos a ver si el modelo nos sirve para ajustar estos datos
library(generalhoslem)
```

```
## Loading required package: reshape
```

```
##
## Attaching package: 'reshape'
```

```
## The following objects are masked from 'package:tidyr':
##
##     expand, smiths
```

```
## The following object is masked from 'package:dplyr':
##
##     rename
```

```
prob=fitted(modeloRL)   #probabilidades estimadas por el modelo
HS=logitgof(datent$`Ganado/Perdido`, prob,g=10)
```

```
## Warning in logitgof(datent$`Ganado/Perdido`, prob, g = 10): At least one cell
## in the expected frequencies table is < 1. Chi-square approximation may be
## incorrect.
```

```
#Nos queda un p-valor de 0.5358, luego podemos concluir que el modelo proporciona un buen ajuste.
```

Modelo con las variables Saque-Tot y Recep-Tot

```
modeloRL1<- glm(`Ganado/Perdido`~.,family=binomial,data=datent[c("Saque-Tot","Recep-Tot","Ganado/Perdido
summary(modeloRL1)
```

```
##
## Call:
## glm(formula = `Ganado/Perdido` ~ ., family = binomial, data = datent[c("Saque-Tot",
##     "Recep-Tot", "Ganado/Perdido")])
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -2.34015  -0.07643   0.00665   0.14805   1.79687
##
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept) -3.54069    2.34929  -1.507    0.132
## `Saque-Tot`  0.38409    0.07376   5.207 1.91e-07 ***
## `Recep-Tot` -0.38966    0.07092  -5.494 3.92e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 256.459  on 184  degrees of freedom
## Residual deviance:  60.297  on 182  degrees of freedom
## AIC: 66.297
##
## Number of Fisher Scoring iterations: 8
```

```
modeloRL1
```

```
##
## Call:  glm(formula = `Ganado/Perdido` ~ ., family = binomial, data = datent[c("Saque-Tot",
##     "Recep-Tot", "Ganado/Perdido")])
##
## Coefficients:
## (Intercept)  `Saque-Tot`  `Recep-Tot`
##     -3.5407       0.3841      -0.3897
##
## Degrees of Freedom: 184 Total (i.e. Null);  182 Residual
## Null Deviance:       256.5
## Residual Deviance: 60.3  AIC: 66.3
```

Ganado/Perdido = -3.5407 + Saque-Tot * 0.3841 + Recep-Tot * -0.3897

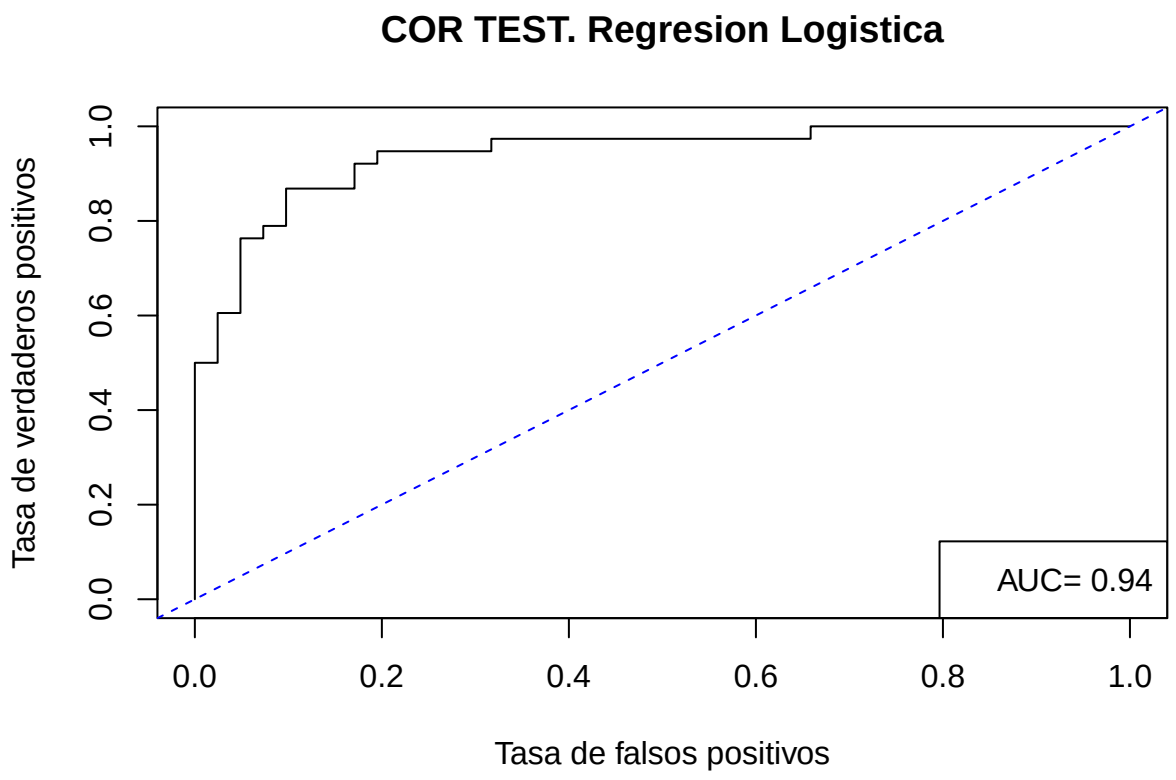
```
preditestRL=as.numeric(predict(modeloRL1,dat[inditest,], type="response")>0.5)
confutestRL<-table(Real=dat[inditest,18]$`Ganado/Perdido`,Predic=preditestRL)
confutestRL
```

```
##     Predic
## Real  0  1
##    0 37  4
##    1  6 32
```

```
AciertoRL=round(100*mean(as.numeric(dattest$`Ganado/Perdido`)==(preditestRL+1)),2)
SensEspecRL=round(100*diag(prop.table(confutestRL,1)),2)
c(AciertoRL, SensEspecRL)
```

```
##           0     1
## 87.34 90.24 84.21
```

```
probabiRL<- predict(modeloRL1,dat[inditest,],type="response") #Prob. 1
prediobjRL<-prediction(probabiRL,dat[inditest,18])
plot(performance(prediobjRL, "tpr","fpr"),
     main="COR TEST. Regresion Logistica",
     xlab="Tasa de falsos positivos",
     ylab="Tasa de verdaderos positivos")
abline(a=0,b=1,col="blue",lty=2)
aucRL<- as.numeric(performance(prediobjRL,"auc")@y.values)
legend("bottomright",legend=paste("AUC=",round(aucRL,3)))
```



```
Resul=rbind(Resul,c(AciertoRL,aucRL,SensEspecRL))
rownames(Resul)=c("Gauss","Kernel(Poisson)","LDA","R.Logistica")
Resul
```

```
##                  Acierto       AUC     0     1
## Gauss              84.81 0.8940950 85.37 84.21
## Kernel(Poisson)    81.01 0.9107831 78.05 84.21
## LDA                88.61 0.9460847 87.80 89.47
## R.Logistica        87.34 0.9403081 90.24 84.21
```

```
levels(dat$`Ganado/Perdido`)=c("Perdido","Ganado")
levels(dattest$`Ganado/Perdido`)=c("Perdido","Ganado")
levels(datent$`Ganado/Perdido`)=c("Perdido","Ganado")
```

Redes Neuronales

a

```
library(NeuralNetTools) #para representar graficamente
```

```
## Warning: package 'NeuralNetTools' was built under R version 4.1.2
```

```
library(caret)
```

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

```
##
## Attaching package: 'caret'
```

```
## The following object is masked from 'package:purrr':
##
##     lift
```

```
ctrlRD <- trainControl(method="cv",classProbs = T,
                       summaryFunction = defaultSummary, verboseIter = F)

modeloPM <- train(`Ganado/Perdido`~ ., data = datent[,-1],
                  method = "nnet",
                  trControl = ctrlRD,
                  preProcess =c("center","scale"),
     tuneGrid=expand.grid(size=1:18,decay=c(0,0.05,0.1)))
```

```
## # weights:  19
## initial  value 123.260327
## iter  10 value 27.722558
## iter  20 value 10.733237
## iter  30 value 6.547430
```

```
## iter  40 value 5.475862
## iter  50 value 5.430152
## iter  60 value 5.428880
## iter  70 value 5.428167
## iter  80 value 5.427570
## iter  90 value 5.427369
## iter 100 value 5.427202
## final  value 5.427202
## stopped after 100 iterations
## # weights:  37
## initial  value 128.560250
## iter  10 value 40.053382
## iter  20 value 12.035875
## iter  30 value 7.218687
## iter  40 value 3.629814
## iter  50 value 3.371055
## iter  60 value 3.366393
## iter  70 value 3.365520
## iter  80 value 3.365278
## iter  90 value 3.365233
## iter  90 value 3.365233
## iter 100 value 3.365210
## final  value 3.365210
## stopped after 100 iterations
## # weights:  55
## initial  value 115.728909
## iter  10 value 16.382625
## iter  20 value 8.268016
## iter  30 value 2.934587
## iter  40 value 2.527363
## iter  50 value 2.505023
## iter  60 value 2.501008
## iter  70 value 2.284794
## iter  80 value 1.087143
## iter  90 value 0.025753
## iter 100 value 0.009747
## final  value 0.009747
## stopped after 100 iterations
## # weights:  73
## initial  value 122.063080
## iter  10 value 12.800896
## iter  20 value 0.880691
## iter  30 value 0.009670
## final  value 0.000085
## converged
## # weights:  91
## initial  value 120.019231
## iter  10 value 16.367425
## iter  20 value 4.134957
## iter  30 value 0.218635
## iter  40 value 0.003359
## iter  50 value 0.000567
## iter  60 value 0.000225
## final  value 0.000094
```

```
## converged
## # weights:  109
## initial  value 132.948877
## iter  10 value 12.531661
## iter  20 value 0.238746
## iter  30 value 0.002400
## iter  40 value 0.000107
## iter  40 value 0.000089
## iter  40 value 0.000087
## final  value 0.000087
## converged
## # weights:  127
## initial  value 116.837564
## iter  10 value 10.075222
## iter  20 value 0.176448
## iter  30 value 0.004024
## iter  40 value 0.000263
## final  value 0.000073
## converged
## # weights:  145
## initial  value 121.007099
## iter  10 value 12.011639
## iter  20 value 0.680328
## iter  30 value 0.036802
## iter  40 value 0.003078
## iter  50 value 0.000719
## iter  60 value 0.000298
## final  value 0.000068
## converged
## # weights:  163
## initial  value 119.407718
## iter  10 value 8.265440
## iter  20 value 0.179480
## iter  30 value 0.007011
## iter  40 value 0.000455
## final  value 0.000073
## converged
## # weights:  181
## initial  value 129.121324
## iter  10 value 8.563703
## iter  20 value 0.121310
## iter  30 value 0.002029
## final  value 0.000093
## converged
## # weights:  199
## initial  value 121.813143
## iter  10 value 9.345151
## iter  20 value 0.205306
## iter  30 value 0.006469
## iter  40 value 0.000423
## iter  50 value 0.000102
## iter  50 value 0.000063
## iter  50 value 0.000062
## final  value 0.000062
```

```
## converged
## # weights:  217
## initial  value 168.735137
## iter  10 value 11.323362
## iter  20 value 0.520856
## iter  30 value 0.005224
## iter  40 value 0.001138
## iter  50 value 0.000221
## iter  60 value 0.000138
## final  value 0.000095
## converged
## # weights:  235
## initial  value 111.420810
## iter  10 value 5.745992
## iter  20 value 0.048315
## iter  30 value 0.002261
## iter  40 value 0.000398
## final  value 0.000099
## converged
## # weights:  253
## initial  value 127.864055
## iter  10 value 14.447039
## iter  20 value 0.253551
## iter  30 value 0.011966
## iter  40 value 0.001546
## iter  50 value 0.000393
## final  value 0.000056
## converged
## # weights:  271
## initial  value 119.749803
## iter  10 value 11.341458
## iter  20 value 0.107427
## iter  30 value 0.001474
## final  value 0.000036
## converged
## # weights:  289
## initial  value 115.240022
## iter  10 value 12.019288
## iter  20 value 0.128391
## iter  30 value 0.002240
## iter  40 value 0.000441
## final  value 0.000089
## converged
## # weights:  307
## initial  value 167.564909
## iter  10 value 9.605724
## iter  20 value 0.153868
## iter  30 value 0.002897
## final  value 0.000099
## converged
## # weights:  325
## initial  value 135.637208
## iter  10 value 10.156361
## iter  20 value 0.044793
```

```
## iter  30 value 0.001977
## iter  40 value 0.000142
## iter  40 value 0.000079
## iter  40 value 0.000078
## final  value 0.000078
## converged
## # weights:  19
## initial  value 118.020877
## iter  10 value 28.023714
## iter  20 value 19.628404
## iter  30 value 19.454082
## final  value 19.453960
## converged
## # weights:  37
## initial  value 118.981621
## iter  10 value 24.212744
## iter  20 value 15.259403
## iter  30 value 14.700839
## iter  40 value 14.510825
## iter  50 value 14.509771
## final  value 14.509770
## converged
## # weights:  55
## initial  value 122.381890
## iter  10 value 34.549678
## iter  20 value 21.493040
## iter  30 value 17.614721
## iter  40 value 15.240656
## iter  50 value 14.904628
## iter  60 value 14.902632
## iter  70 value 14.902511
## final  value 14.902507
## converged
## # weights:  73
## initial  value 117.650984
## iter  10 value 40.174544
## iter  20 value 21.140059
## iter  30 value 15.522536
## iter  40 value 13.923561
## iter  50 value 13.165336
## iter  60 value 12.964662
## iter  70 value 12.843142
## iter  80 value 12.766330
## iter  90 value 12.652206
## iter 100 value 12.615604
## final  value 12.615604
## stopped after 100 iterations
## # weights:  91
## initial  value 119.435360
## iter  10 value 20.774688
## iter  20 value 14.262326
## iter  30 value 13.415740
## iter  40 value 12.836140
## iter  50 value 12.599974
```

```
## iter  60 value 12.425332
## iter  70 value 12.363198
## iter  80 value 12.352946
## iter  90 value 12.352705
## iter 100 value 12.352692
## final  value 12.352692
## stopped after 100 iterations
## # weights:  109
## initial  value 125.282682
## iter  10 value 20.016123
## iter  20 value 14.795097
## iter  30 value 12.711005
## iter  40 value 12.261129
## iter  50 value 12.147331
## iter  60 value 12.105560
## iter  70 value 12.092414
## iter  80 value 12.087598
## iter  90 value 12.087299
## iter 100 value 12.066939
## final  value 12.066939
## stopped after 100 iterations
## # weights:  127
## initial  value 120.384855
## iter  10 value 37.538351
## iter  20 value 18.740274
## iter  30 value 14.502657
## iter  40 value 13.028636
## iter  50 value 12.211373
## iter  60 value 12.071128
## iter  70 value 11.997567
## iter  80 value 11.985868
## iter  90 value 11.970680
## iter 100 value 11.868381
## final  value 11.868381
## stopped after 100 iterations
## # weights:  145
## initial  value 134.683848
## iter  10 value 18.904130
## iter  20 value 14.738399
## iter  30 value 12.743665
## iter  40 value 12.064864
## iter  50 value 11.835490
## iter  60 value 11.799572
## iter  70 value 11.794032
## iter  80 value 11.791623
## iter  90 value 11.791259
## iter 100 value 11.791243
## final  value 11.791243
## stopped after 100 iterations
## # weights:  163
## initial  value 134.566272
## iter  10 value 20.144923
## iter  20 value 13.741478
## iter  30 value 12.336281
```

```
## iter  40 value 11.914315
## iter  50 value 11.684621
## iter  60 value 11.542436
## iter  70 value 11.432704
## iter  80 value 11.338125
## iter  90 value 11.293143
## iter 100 value 11.288792
## final  value 11.288792
## stopped after 100 iterations
## # weights:  181
## initial  value 130.473119
## iter  10 value 17.255937
## iter  20 value 12.876626
## iter  30 value 11.917532
## iter  40 value 11.500945
## iter  50 value 11.386591
## iter  60 value 11.345347
## iter  70 value 11.332736
## iter  80 value 11.324534
## iter  90 value 11.322386
## iter 100 value 11.321921
## final  value 11.321921
## stopped after 100 iterations
## # weights:  199
## initial  value 121.847866
## iter  10 value 17.236432
## iter  20 value 12.659548
## iter  30 value 11.815458
## iter  40 value 11.517809
## iter  50 value 11.372969
## iter  60 value 11.328833
## iter  70 value 11.305170
## iter  80 value 11.220987
## iter  90 value 11.200359
## iter 100 value 11.199087
## final  value 11.199087
## stopped after 100 iterations
## # weights:  217
## initial  value 116.836576
## iter  10 value 34.856478
## iter  20 value 15.338954
## iter  30 value 12.164715
## iter  40 value 11.666114
## iter  50 value 11.543401
## iter  60 value 11.473278
## iter  70 value 11.449356
## iter  80 value 11.391198
## iter  90 value 11.293965
## iter 100 value 11.280253
## final  value 11.280253
## stopped after 100 iterations
## # weights:  235
## initial  value 165.727070
## iter  10 value 21.014631
```

```
## iter  20 value 13.731648
## iter  30 value 11.934959
## iter  40 value 11.374666
## iter  50 value 11.249960
## iter  60 value 11.217202
## iter  70 value 11.200074
## iter  80 value 11.192190
## iter  90 value 11.185434
## iter 100 value 11.179187
## final  value 11.179187
## stopped after 100 iterations
## # weights:  253
## initial  value 123.094708
## iter  10 value 18.170261
## iter  20 value 12.732910
## iter  30 value 11.526264
## iter  40 value 11.306818
## iter  50 value 11.229770
## iter  60 value 11.168921
## iter  70 value 11.158243
## iter  80 value 11.126943
## iter  90 value 11.119243
## iter 100 value 11.110534
## final  value 11.110534
## stopped after 100 iterations
## # weights:  271
## initial  value 152.853054
## iter  10 value 21.700341
## iter  20 value 14.083264
## iter  30 value 12.034128
## iter  40 value 11.358850
## iter  50 value 11.225276
## iter  60 value 11.170853
## iter  70 value 11.149287
## iter  80 value 11.135151
## iter  90 value 11.126855
## iter 100 value 11.107413
## final  value 11.107413
## stopped after 100 iterations
## # weights:  289
## initial  value 135.200707
## iter  10 value 17.888481
## iter  20 value 12.304123
## iter  30 value 11.469511
## iter  40 value 11.240924
## iter  50 value 11.141671
## iter  60 value 11.105396
## iter  70 value 11.089752
## iter  80 value 11.082415
## iter  90 value 11.079149
## iter 100 value 11.076789
## final  value 11.076789
## stopped after 100 iterations
## # weights:  307
```

```
## initial  value 149.256141
## iter  10 value 20.137897
## iter  20 value 13.232138
## iter  30 value 11.748164
## iter  40 value 11.484913
## iter  50 value 11.379264
## iter  60 value 11.338982
## iter  70 value 11.323565
## iter  80 value 11.300111
## iter  90 value 11.279249
## iter 100 value 11.257385
## final  value 11.257385
## stopped after 100 iterations
## # weights:  325
## initial  value 117.820512
## iter  10 value 18.009576
## iter  20 value 12.877600
## iter  30 value 11.843006
## iter  40 value 11.443773
## iter  50 value 11.188206
## iter  60 value 11.110771
## iter  70 value 11.093811
## iter  80 value 11.070515
## iter  90 value 11.063313
## iter 100 value 11.062131
## final  value 11.062131
## stopped after 100 iterations
## # weights:  19
## initial  value 115.046626
## iter  10 value 31.418804
## iter  20 value 25.883761
## iter  30 value 25.851924
## final  value 25.851923
## converged
## # weights:  37
## initial  value 115.521472
## iter  10 value 38.478569
## iter  20 value 23.253283
## iter  30 value 21.027012
## iter  40 value 20.889909
## final  value 20.889848
## converged
## # weights:  55
## initial  value 121.831780
## iter  10 value 24.678431
## iter  20 value 20.261240
## iter  30 value 19.674570
## iter  40 value 19.521225
## iter  50 value 19.514124
## final  value 19.514102
## converged
## # weights:  73
## initial  value 120.045276
## iter  10 value 35.130122
```

```
## iter  20 value 23.558739
## iter  30 value 20.211597
## iter  40 value 19.300052
## iter  50 value 19.162880
## iter  60 value 19.131301
## iter  70 value 19.130886
## final  value 19.130885
## converged
## # weights:  91
## initial  value 132.543573
## iter  10 value 35.677734
## iter  20 value 21.113329
## iter  30 value 19.490037
## iter  40 value 18.811097
## iter  50 value 18.575649
## iter  60 value 18.565910
## iter  70 value 18.563929
## iter  80 value 18.563678
## final  value 18.563677
## converged
## # weights:  109
## initial  value 116.978701
## iter  10 value 24.373604
## iter  20 value 20.152265
## iter  30 value 18.853624
## iter  40 value 18.513576
## iter  50 value 18.376153
## iter  60 value 18.357019
## iter  70 value 18.356102
## final  value 18.356085
## converged
## # weights:  127
## initial  value 132.221967
## iter  10 value 29.834888
## iter  20 value 21.245972
## iter  30 value 19.250918
## iter  40 value 18.230743
## iter  50 value 18.024575
## iter  60 value 17.953222
## iter  70 value 17.945337
## iter  80 value 17.944952
## iter  90 value 17.944918
## iter 100 value 17.944911
## final  value 17.944911
## stopped after 100 iterations
## # weights:  145
## initial  value 117.727351
## iter  10 value 46.526434
## iter  20 value 20.678654
## iter  30 value 19.152545
## iter  40 value 18.702521
## iter  50 value 18.578517
## iter  60 value 18.497379
## iter  70 value 18.309456
```

```
## iter  80 value 18.122170
## iter  90 value 17.829188
## iter 100 value 17.776104
## final  value 17.776104
## stopped after 100 iterations
## # weights:  163
## initial  value 141.272674
## iter  10 value 37.999796
## iter  20 value 22.111417
## iter  30 value 19.269308
## iter  40 value 18.273837
## iter  50 value 17.875706
## iter  60 value 17.785989
## iter  70 value 17.764499
## iter  80 value 17.761556
## iter  90 value 17.760258
## iter 100 value 17.759030
## final  value 17.759030
## stopped after 100 iterations
## # weights:  181
## initial  value 138.516257
## iter  10 value 26.970207
## iter  20 value 19.131520
## iter  30 value 18.134854
## iter  40 value 17.720205
## iter  50 value 17.681208
## iter  60 value 17.633389
## iter  70 value 17.618763
## iter  80 value 17.613920
## iter  90 value 17.613155
## iter 100 value 17.613079
## final  value 17.613079
## stopped after 100 iterations
## # weights:  199
## initial  value 117.038169
## iter  10 value 25.174729
## iter  20 value 18.918958
## iter  30 value 18.258533
## iter  40 value 17.956084
## iter  50 value 17.736244
## iter  60 value 17.686863
## iter  70 value 17.651579
## iter  80 value 17.599189
## iter  90 value 17.596304
## iter 100 value 17.594438
## final  value 17.594438
## stopped after 100 iterations
## # weights:  217
## initial  value 121.291901
## iter  10 value 27.571432
## iter  20 value 19.707670
## iter  30 value 18.217216
## iter  40 value 17.915935
## iter  50 value 17.716191
```

```
## iter  60 value 17.695729
## iter  70 value 17.680842
## iter  80 value 17.675457
## iter  90 value 17.675226
## iter 100 value 17.674350
## final  value 17.674350
## stopped after 100 iterations
## # weights:  235
## initial  value 114.981718
## iter  10 value 33.660103
## iter  20 value 19.948404
## iter  30 value 18.429886
## iter  40 value 18.056853
## iter  50 value 17.918670
## iter  60 value 17.876436
## iter  70 value 17.797410
## iter  80 value 17.731371
## iter  90 value 17.709627
## iter 100 value 17.706852
## final  value 17.706852
## stopped after 100 iterations
## # weights:  253
## initial  value 147.578446
## iter  10 value 21.346772
## iter  20 value 18.448256
## iter  30 value 17.816739
## iter  40 value 17.616350
## iter  50 value 17.554612
## iter  60 value 17.545526
## iter  70 value 17.544252
## iter  80 value 17.543781
## iter  90 value 17.543746
## final  value 17.543746
## converged
## # weights:  271
## initial  value 125.392155
## iter  10 value 23.188676
## iter  20 value 18.434567
## iter  30 value 17.870525
## iter  40 value 17.688518
## iter  50 value 17.597900
## iter  60 value 17.551291
## iter  70 value 17.528961
## iter  80 value 17.526950
## iter  90 value 17.526807
## iter 100 value 17.526751
## final  value 17.526751
## stopped after 100 iterations
## # weights:  289
## initial  value 130.544121
## iter  10 value 32.772184
## iter  20 value 19.598093
## iter  30 value 18.098735
## iter  40 value 17.668701
```

```
## iter  50 value 17.538277
## iter  60 value 17.508932
## iter  70 value 17.490921
## iter  80 value 17.487339
## iter  90 value 17.484781
## iter 100 value 17.483626
## final  value 17.483626
## stopped after 100 iterations
## # weights:  307
## initial  value 118.238151
## iter  10 value 25.502864
## iter  20 value 19.075197
## iter  30 value 17.916991
## iter  40 value 17.738165
## iter  50 value 17.670542
## iter  60 value 17.628916
## iter  70 value 17.616231
## iter  80 value 17.615725
## iter  90 value 17.615690
## final  value 17.615681
## converged
## # weights:  325
## initial  value 148.661052
## iter  10 value 25.249438
## iter  20 value 18.529352
## iter  30 value 17.855819
## iter  40 value 17.590877
## iter  50 value 17.537270
## iter  60 value 17.523202
## iter  70 value 17.522327
## iter  80 value 17.522066
## iter  90 value 17.521954
## iter 100 value 17.521948
## final  value 17.521948
## stopped after 100 iterations
## # weights:  19
## initial  value 113.794093
## iter  10 value 52.349592
## iter  20 value 45.808081
## iter  30 value 36.358458
## iter  40 value 29.531516
## iter  50 value 25.019321
## iter  60 value 23.393469
## iter  70 value 13.694192
## iter  80 value 13.038838
## iter  90 value 13.030423
## iter 100 value 13.025575
## final  value 13.025575
## stopped after 100 iterations
## # weights:  37
## initial  value 113.722367
## iter  10 value 22.221381
## iter  20 value 10.132290
## iter  30 value 5.270141
```

```
## iter  40 value 4.795880
## iter  50 value 4.781391
## iter  60 value 4.780392
## final  value 4.780359
## converged
## # weights:  55
## initial  value 129.900902
## iter  10 value 23.803216
## iter  20 value 17.127334
## iter  30 value 13.256129
## iter  40 value 7.563066
## iter  50 value 6.747380
## iter  60 value 6.630551
## iter  70 value 6.550702
## iter  80 value 6.289282
## iter  90 value 6.096565
## iter 100 value 5.727497
## final  value 5.727497
## stopped after 100 iterations
## # weights:  73
## initial  value 128.378227
## iter  10 value 21.179393
## iter  20 value 5.857817
## iter  30 value 0.317154
## iter  40 value 0.002559
## iter  50 value 0.000279
## final  value 0.000077
## converged
## # weights:  91
## initial  value 107.293546
## iter  10 value 11.240363
## iter  20 value 0.283035
## iter  30 value 0.000843
## final  value 0.000077
## converged
## # weights:  109
## initial  value 123.683628
## iter  10 value 18.560477
## iter  20 value 4.118849
## iter  30 value 0.038032
## iter  40 value 0.001866
## iter  50 value 0.000557
## iter  60 value 0.000154
## final  value 0.000069
## converged
## # weights:  127
## initial  value 131.217823
## iter  10 value 11.191892
## iter  20 value 0.326485
## iter  30 value 0.004693
## iter  40 value 0.000124
## final  value 0.000066
## converged
## # weights:  145
```

```
## initial  value 134.426132
## iter  10 value 17.552744
## iter  20 value 1.821847
## iter  30 value 0.015078
## iter  40 value 0.000655
## iter  50 value 0.000101
## iter  50 value 0.000088
## iter  50 value 0.000087
## final  value 0.000087
## converged
## # weights:  163
## initial  value 120.254771
## iter  10 value 15.464546
## iter  20 value 2.256451
## iter  30 value 0.045669
## iter  40 value 0.004112
## iter  50 value 0.000312
## iter  60 value 0.000134
## iter  60 value 0.000096
## iter  60 value 0.000096
## final  value 0.000096
## converged
## # weights:  181
## initial  value 115.456216
## iter  10 value 14.842353
## iter  20 value 3.713437
## iter  30 value 0.080184
## iter  40 value 0.006148
## iter  50 value 0.001222
## iter  60 value 0.000475
## final  value 0.000099
## converged
## # weights:  199
## initial  value 124.555879
## iter  10 value 16.620613
## iter  20 value 9.367736
## iter  30 value 2.288934
## iter  40 value 0.052291
## iter  50 value 0.008048
## iter  60 value 0.001781
## iter  70 value 0.000626
## iter  80 value 0.000131
## iter  80 value 0.000089
## iter  80 value 0.000088
## final  value 0.000088
## converged
## # weights:  217
## initial  value 154.846478
## iter  10 value 17.920844
## iter  20 value 0.528318
## iter  30 value 0.010115
## iter  40 value 0.002250
## iter  50 value 0.000753
## iter  60 value 0.000253
```

```
## final  value 0.000074
## converged
## # weights:  235
## initial  value 111.522022
## iter  10 value 9.969157
## iter  20 value 0.385806
## iter  30 value 0.018769
## iter  40 value 0.002896
## iter  50 value 0.000528
## iter  60 value 0.000309
## final  value 0.000088
## converged
## # weights:  253
## initial  value 149.379718
## iter  10 value 6.326576
## iter  20 value 0.255666
## iter  30 value 0.035582
## iter  40 value 0.006290
## iter  50 value 0.002159
## final  value 0.000088
## converged
## # weights:  271
## initial  value 141.725595
## iter  10 value 11.095032
## iter  20 value 0.563611
## iter  30 value 0.010063
## iter  40 value 0.001111
## final  value 0.000082
## converged
## # weights:  289
## initial  value 118.363121
## iter  10 value 10.977429
## iter  20 value 0.195078
## iter  30 value 0.001114
## iter  40 value 0.000106
## iter  40 value 0.000082
## iter  40 value 0.000081
## final  value 0.000081
## converged
## # weights:  307
## initial  value 115.737173
## iter  10 value 10.453230
## iter  20 value 0.106445
## iter  30 value 0.002350
## final  value 0.000069
## converged
## # weights:  325
## initial  value 125.363206
## iter  10 value 14.499520
## iter  20 value 0.419904
## iter  30 value 0.007632
## iter  40 value 0.000962
## iter  50 value 0.000310
## iter  60 value 0.000158
```

```
## final  value 0.000080
## converged
## # weights:  19
## initial  value 108.172175
## iter  10 value 42.693053
## iter  20 value 23.662772
## iter  30 value 22.725851
## final  value 22.718648
## converged
## # weights:  37
## initial  value 116.129445
## iter  10 value 34.288857
## iter  20 value 22.260178
## iter  30 value 19.884540
## iter  40 value 17.644492
## iter  50 value 17.428722
## iter  60 value 17.417901
## iter  70 value 17.416822
## final  value 17.416780
## converged
## # weights:  55
## initial  value 114.856094
## iter  10 value 30.556084
## iter  20 value 16.102521
## iter  30 value 14.719414
## iter  40 value 14.641504
## iter  50 value 14.628053
## final  value 14.627990
## converged
## # weights:  73
## initial  value 114.147456
## iter  10 value 33.405122
## iter  20 value 21.545500
## iter  30 value 17.004515
## iter  40 value 14.751938
## iter  50 value 14.193719
## iter  60 value 14.129202
## iter  70 value 14.119931
## iter  80 value 14.118766
## iter  90 value 14.118715
## final  value 14.118711
## converged
## # weights:  91
## initial  value 115.295482
## iter  10 value 18.863177
## iter  20 value 14.612613
## iter  30 value 14.096789
## iter  40 value 13.750982
## iter  50 value 13.705222
## iter  60 value 13.593923
## iter  70 value 13.569852
## iter  80 value 13.547330
## iter  90 value 13.542576
## iter 100 value 13.541765
```

```
## final  value 13.541765
## stopped after 100 iterations
## # weights:  109
## initial  value 119.523818
## iter  10 value 24.581751
## iter  20 value 15.905909
## iter  30 value 13.871482
## iter  40 value 13.300592
## iter  50 value 13.050172
## iter  60 value 12.944090
## iter  70 value 12.927674
## iter  80 value 12.926116
## final  value 12.926097
## converged
## # weights:  127
## initial  value 130.026424
## iter  10 value 33.949563
## iter  20 value 16.791176
## iter  30 value 13.955706
## iter  40 value 13.448151
## iter  50 value 13.299946
## iter  60 value 13.152710
## iter  70 value 13.026302
## iter  80 value 12.799776
## iter  90 value 12.736621
## iter 100 value 12.723875
## final  value 12.723875
## stopped after 100 iterations
## # weights:  145
## initial  value 137.796110
## iter  10 value 22.298386
## iter  20 value 15.397864
## iter  30 value 13.632684
## iter  40 value 13.280031
## iter  50 value 13.254476
## iter  60 value 13.238778
## iter  70 value 13.117536
## iter  80 value 13.042449
## iter  90 value 13.031748
## iter 100 value 13.030010
## final  value 13.030010
## stopped after 100 iterations
## # weights:  163
## initial  value 101.700170
## iter  10 value 19.238586
## iter  20 value 14.560764
## iter  30 value 13.223113
## iter  40 value 12.804283
## iter  50 value 12.722813
## iter  60 value 12.684370
## iter  70 value 12.626711
## iter  80 value 12.621035
## iter  90 value 12.620473
## iter 100 value 12.620283
```

```
## final  value 12.620283
## stopped after 100 iterations
## # weights:  181
## initial  value 126.743712
## iter  10 value 20.464212
## iter  20 value 14.298551
## iter  30 value 13.154907
## iter  40 value 12.787607
## iter  50 value 12.701106
## iter  60 value 12.673940
## iter  70 value 12.663063
## iter  80 value 12.660668
## iter  90 value 12.660205
## iter 100 value 12.660015
## final  value 12.660015
## stopped after 100 iterations
## # weights:  199
## initial  value 124.280560
## iter  10 value 20.851553
## iter  20 value 14.354022
## iter  30 value 13.036616
## iter  40 value 12.610432
## iter  50 value 12.545160
## iter  60 value 12.522780
## iter  70 value 12.515552
## iter  80 value 12.514231
## iter  90 value 12.513393
## iter 100 value 12.513314
## final  value 12.513314
## stopped after 100 iterations
## # weights:  217
## initial  value 130.082185
## iter  10 value 20.624412
## iter  20 value 14.755992
## iter  30 value 13.081307
## iter  40 value 12.753261
## iter  50 value 12.631045
## iter  60 value 12.592037
## iter  70 value 12.578525
## iter  80 value 12.562350
## iter  90 value 12.553179
## iter 100 value 12.523455
## final  value 12.523455
## stopped after 100 iterations
## # weights:  235
## initial  value 120.243428
## iter  10 value 22.445068
## iter  20 value 14.926485
## iter  30 value 13.350486
## iter  40 value 12.730976
## iter  50 value 12.560561
## iter  60 value 12.548013
## iter  70 value 12.547206
## iter  80 value 12.547087
```

```
## iter  90 value 12.546927
## iter 100 value 12.546864
## final  value 12.546864
## stopped after 100 iterations
## # weights:  253
## initial  value 156.460536
## iter  10 value 19.845885
## iter  20 value 14.087084
## iter  30 value 12.919341
## iter  40 value 12.627366
## iter  50 value 12.536418
## iter  60 value 12.502715
## iter  70 value 12.476030
## iter  80 value 12.462901
## iter  90 value 12.462040
## iter 100 value 12.461883
## final  value 12.461883
## stopped after 100 iterations
## # weights:  271
## initial  value 117.440563
## iter  10 value 23.925495
## iter  20 value 14.460366
## iter  30 value 13.096085
## iter  40 value 12.666184
## iter  50 value 12.555629
## iter  60 value 12.511819
## iter  70 value 12.496627
## iter  80 value 12.482252
## iter  90 value 12.478670
## iter 100 value 12.478337
## final  value 12.478337
## stopped after 100 iterations
## # weights:  289
## initial  value 136.099751
## iter  10 value 24.550636
## iter  20 value 15.393725
## iter  30 value 13.267353
## iter  40 value 12.806050
## iter  50 value 12.562474
## iter  60 value 12.494035
## iter  70 value 12.480744
## iter  80 value 12.467826
## iter  90 value 12.464251
## iter 100 value 12.462677
## final  value 12.462677
## stopped after 100 iterations
## # weights:  307
## initial  value 148.156248
## iter  10 value 21.036004
## iter  20 value 13.707425
## iter  30 value 12.896474
## iter  40 value 12.618138
## iter  50 value 12.533332
## iter  60 value 12.482744
```

```
## iter  70 value 12.475010
## iter  80 value 12.465876
## iter  90 value 12.462120
## iter 100 value 12.453595
## final  value 12.453595
## stopped after 100 iterations
## # weights:  325
## initial  value 160.622950
## iter  10 value 23.325129
## iter  20 value 15.425307
## iter  30 value 13.161731
## iter  40 value 12.587288
## iter  50 value 12.495574
## iter  60 value 12.466462
## iter  70 value 12.451906
## iter  80 value 12.447391
## iter  90 value 12.445023
## iter 100 value 12.440327
## final  value 12.440327
## stopped after 100 iterations
## # weights:  19
## initial  value 117.667295
## iter  10 value 38.538183
## iter  20 value 29.035811
## iter  30 value 27.672648
## final  value 27.666237
## converged
## # weights:  37
## initial  value 127.788092
## iter  10 value 34.142077
## iter  20 value 25.148284
## iter  30 value 24.468210
## iter  40 value 24.433684
## final  value 24.433643
## converged
## # weights:  55
## initial  value 118.812947
## iter  10 value 41.904018
## iter  20 value 26.848379
## iter  30 value 23.310761
## iter  40 value 22.021818
## iter  50 value 21.113250
## iter  60 value 20.987772
## iter  70 value 20.979144
## final  value 20.979108
## converged
## # weights:  73
## initial  value 114.161130
## iter  10 value 30.410693
## iter  20 value 22.649220
## iter  30 value 21.331861
## iter  40 value 21.036426
## iter  50 value 20.551631
## iter  60 value 20.359689
```

```
## iter  70 value 20.355493
## iter  80 value 20.349676
## iter  90 value 20.349413
## final  value 20.349412
## converged
## # weights:  91
## initial  value 158.813505
## iter  10 value 29.187285
## iter  20 value 22.545014
## iter  30 value 20.633489
## iter  40 value 20.400562
## iter  50 value 20.307597
## iter  60 value 20.185296
## iter  70 value 20.094788
## iter  80 value 20.067892
## iter  90 value 20.063156
## iter 100 value 20.062734
## final  value 20.062734
## stopped after 100 iterations
## # weights:  109
## initial  value 126.673109
## iter  10 value 30.813181
## iter  20 value 21.851919
## iter  30 value 20.272014
## iter  40 value 19.989342
## iter  50 value 19.937822
## iter  60 value 19.933175
## iter  70 value 19.932742
## final  value 19.932701
## converged
## # weights:  127
## initial  value 125.237323
## iter  10 value 26.155892
## iter  20 value 21.174565
## iter  30 value 20.141270
## iter  40 value 19.866246
## iter  50 value 19.779337
## iter  60 value 19.700062
## iter  70 value 19.692903
## iter  80 value 19.689421
## iter  90 value 19.689001
## iter 100 value 19.688986
## final  value 19.688986
## stopped after 100 iterations
## # weights:  145
## initial  value 127.574612
## iter  10 value 30.380433
## iter  20 value 22.484476
## iter  30 value 20.061251
## iter  40 value 19.551182
## iter  50 value 19.453049
## iter  60 value 19.421996
## iter  70 value 19.387103
## iter  80 value 19.381950
```

```
## iter  90 value 19.380980
## iter 100 value 19.380906
## final  value 19.380906
## stopped after 100 iterations
## # weights:  163
## initial  value 121.355951
## iter  10 value 27.078315
## iter  20 value 20.128295
## iter  30 value 19.634307
## iter  40 value 19.513098
## iter  50 value 19.475235
## iter  60 value 19.473461
## iter  70 value 19.473221
## iter  80 value 19.473016
## iter  90 value 19.465985
## iter 100 value 19.457501
## final  value 19.457501
## stopped after 100 iterations
## # weights:  181
## initial  value 124.408586
## iter  10 value 41.265839
## iter  20 value 22.560803
## iter  30 value 20.096586
## iter  40 value 19.673528
## iter  50 value 19.522627
## iter  60 value 19.413390
## iter  70 value 19.294388
## iter  80 value 19.272518
## iter  90 value 19.260007
## iter 100 value 19.245504
## final  value 19.245504
## stopped after 100 iterations
## # weights:  199
## initial  value 148.330845
## iter  10 value 26.284572
## iter  20 value 20.404695
## iter  30 value 19.564845
## iter  40 value 19.308196
## iter  50 value 19.226669
## iter  60 value 19.218532
## iter  70 value 19.215808
## iter  80 value 19.215163
## iter  90 value 19.215096
## iter 100 value 19.215078
## final  value 19.215078
## stopped after 100 iterations
## # weights:  217
## initial  value 140.590524
## iter  10 value 25.878786
## iter  20 value 19.983475
## iter  30 value 19.521522
## iter  40 value 19.316154
## iter  50 value 19.205124
## iter  60 value 19.182781
```

```
## iter  70 value 19.176749
## iter  80 value 19.159121
## iter  90 value 19.155172
## iter 100 value 19.153768
## final  value 19.153768
## stopped after 100 iterations
## # weights:  235
## initial  value 125.268993
## iter  10 value 23.120429
## iter  20 value 19.812631
## iter  30 value 19.347174
## iter  40 value 19.226391
## iter  50 value 19.159045
## iter  60 value 19.137751
## iter  70 value 19.130956
## iter  80 value 19.129884
## iter  90 value 19.129360
## iter 100 value 19.129222
## final  value 19.129222
## stopped after 100 iterations
## # weights:  253
## initial  value 135.463298
## iter  10 value 24.493889
## iter  20 value 19.943840
## iter  30 value 19.453400
## iter  40 value 19.258539
## iter  50 value 19.160929
## iter  60 value 19.145148
## iter  70 value 19.142004
## iter  80 value 19.141106
## iter  90 value 19.141033
## final  value 19.141029
## converged
## # weights:  271
## initial  value 130.104666
## iter  10 value 34.673502
## iter  20 value 21.441448
## iter  30 value 19.558333
## iter  40 value 19.223395
## iter  50 value 19.143989
## iter  60 value 19.123509
## iter  70 value 19.116992
## iter  80 value 19.112631
## iter  90 value 19.108845
## iter 100 value 19.105292
## final  value 19.105292
## stopped after 100 iterations
## # weights:  289
## initial  value 140.848605
## iter  10 value 24.606095
## iter  20 value 19.963304
## iter  30 value 19.488237
## iter  40 value 19.261928
## iter  50 value 19.155429
```

```
## iter  60 value 19.133569
## iter  70 value 19.126037
## iter  80 value 19.124101
## iter  90 value 19.122911
## iter 100 value 19.120445
## final  value 19.120445
## stopped after 100 iterations
## # weights:  307
## initial  value 113.763890
## iter  10 value 24.247914
## iter  20 value 20.088306
## iter  30 value 19.516334
## iter  40 value 19.264782
## iter  50 value 19.169369
## iter  60 value 19.136485
## iter  70 value 19.127134
## iter  80 value 19.122199
## iter  90 value 19.120220
## iter 100 value 19.090503
## final  value 19.090503
## stopped after 100 iterations
## # weights:  325
## initial  value 127.393243
## iter  10 value 25.513132
## iter  20 value 19.850211
## iter  30 value 19.275963
## iter  40 value 19.160628
## iter  50 value 19.095338
## iter  60 value 19.082802
## iter  70 value 19.079690
## iter  80 value 19.079212
## iter  90 value 19.078976
## iter 100 value 19.078898
## final  value 19.078898
## stopped after 100 iterations
## # weights:  19
## initial  value 122.890468
## iter  10 value 25.150554
## iter  20 value 18.169372
## iter  30 value 16.214814
## iter  40 value 13.157571
## iter  50 value 13.128960
## iter  60 value 13.091626
## iter  70 value 13.084310
## iter  80 value 13.082233
## iter  90 value 13.081838
## iter 100 value 13.080379
## final  value 13.080379
## stopped after 100 iterations
## # weights:  37
## initial  value 119.283530
## iter  10 value 43.806746
## iter  20 value 23.907009
## iter  30 value 16.832520
```

```
## iter  40 value 5.667614
## iter  50 value 4.627682
## iter  60 value 4.079443
## iter  70 value 4.027368
## iter  80 value 3.952259
## iter  90 value 3.887288
## iter 100 value 3.841075
## final  value 3.841075
## stopped after 100 iterations
## # weights:  55
## initial  value 128.729108
## iter  10 value 25.775797
## iter  20 value 6.891344
## iter  30 value 3.668302
## iter  40 value 3.367412
## iter  50 value 3.365214
## iter  60 value 3.365058
## iter  60 value 3.365058
## iter  60 value 3.365058
## final  value 3.365058
## converged
## # weights:  73
## initial  value 121.174658
## iter  10 value 18.448584
## iter  20 value 6.253510
## iter  30 value 0.082838
## iter  40 value 0.001321
## final  value 0.000075
## converged
## # weights:  91
## initial  value 118.459467
## iter  10 value 15.528134
## iter  20 value 3.469696
## iter  30 value 2.709511
## iter  40 value 2.703459
## iter  50 value 2.703372
## final  value 2.703367
## converged
## # weights:  109
## initial  value 140.592119
## iter  10 value 12.941479
## iter  20 value 3.695594
## iter  30 value 1.385603
## iter  40 value 0.112229
## iter  50 value 0.051419
## iter  60 value 0.020020
## iter  70 value 0.006645
## iter  80 value 0.003278
## iter  90 value 0.001003
## iter 100 value 0.000498
## final  value 0.000498
## stopped after 100 iterations
## # weights:  127
## initial  value 118.284742
```

```
## iter  10 value 18.206046
## iter  20 value 1.048821
## iter  30 value 0.008083
## iter  40 value 0.000243
## final  value 0.000058
## converged
## # weights:  145
## initial  value 121.599084
## iter  10 value 17.520937
## iter  20 value 5.965390
## iter  30 value 5.723379
## iter  40 value 2.365026
## iter  50 value 2.257682
## iter  60 value 2.254197
## iter  70 value 2.250318
## iter  80 value 2.250061
## iter  90 value 2.249934
## iter 100 value 2.249578
## final  value 2.249578
## stopped after 100 iterations
## # weights:  163
## initial  value 130.575766
## iter  10 value 16.679185
## iter  20 value 0.505846
## iter  30 value 0.002816
## final  value 0.000089
## converged
## # weights:  181
## initial  value 121.942683
## iter  10 value 12.672735
## iter  20 value 1.302620
## iter  30 value 0.011148
## iter  40 value 0.000153
## final  value 0.000097
## converged
## # weights:  199
## initial  value 134.270793
## iter  10 value 16.438116
## iter  20 value 0.725322
## iter  30 value 0.016414
## iter  40 value 0.000945
## iter  50 value 0.000143
## final  value 0.000092
## converged
## # weights:  217
## initial  value 152.427980
## iter  10 value 12.148414
## iter  20 value 1.188287
## iter  30 value 0.015640
## iter  40 value 0.000483
## final  value 0.000096
## converged
## # weights:  235
## initial  value 124.884010
```

```
## iter  10 value 16.581110
## iter  20 value 0.690517
## iter  30 value 0.010477
## iter  40 value 0.000937
## iter  50 value 0.000108
## iter  50 value 0.000092
## iter  50 value 0.000089
## final  value 0.000089
## converged
## # weights:  253
## initial  value 134.529723
## iter  10 value 8.273649
## iter  20 value 0.218435
## iter  30 value 0.001532
## final  value 0.000096
## converged
## # weights:  271
## initial  value 144.250268
## iter  10 value 15.126310
## iter  20 value 0.697138
## iter  30 value 0.008656
## iter  40 value 0.000140
## iter  40 value 0.000083
## iter  40 value 0.000082
## final  value 0.000082
## converged
## # weights:  289
## initial  value 109.765679
## iter  10 value 8.191177
## iter  20 value 0.091367
## iter  30 value 0.001271
## final  value 0.000077
## converged
## # weights:  307
## initial  value 148.394979
## iter  10 value 14.000905
## iter  20 value 0.762764
## iter  30 value 0.003651
## iter  40 value 0.000337
## final  value 0.000098
## converged
## # weights:  325
## initial  value 143.642858
## iter  10 value 12.734708
## iter  20 value 1.084032
## iter  30 value 0.008246
## iter  40 value 0.001014
## final  value 0.000073
## converged
## # weights:  19
## initial  value 123.997805
## iter  10 value 57.288853
## iter  20 value 27.788299
## iter  30 value 25.894022
```

```
## iter  40 value 25.884911
## iter  50 value 25.884534
## final  value 25.884521
## converged
## # weights:  37
## initial  value 137.730812
## iter  10 value 43.959860
## iter  20 value 25.206499
## iter  30 value 21.557609
## iter  40 value 21.022309
## iter  50 value 20.981181
## final  value 20.980788
## converged
## # weights:  55
## initial  value 130.450421
## iter  10 value 34.246597
## iter  20 value 18.189010
## iter  30 value 15.472662
## iter  40 value 15.006013
## iter  50 value 14.982057
## iter  60 value 14.979414
## final  value 14.979410
## converged
## # weights:  73
## initial  value 125.962826
## iter  10 value 33.308274
## iter  20 value 17.939869
## iter  30 value 15.219942
## iter  40 value 15.044320
## iter  50 value 14.824311
## iter  60 value 14.737174
## iter  70 value 14.722062
## iter  80 value 14.715927
## iter  90 value 14.703178
## final  value 14.703151
## converged
## # weights:  91
## initial  value 116.954018
## iter  10 value 25.421698
## iter  20 value 17.517516
## iter  30 value 15.690109
## iter  40 value 14.481733
## iter  50 value 14.079380
## iter  60 value 13.935130
## iter  70 value 13.903695
## iter  80 value 13.901077
## iter  90 value 13.898698
## iter 100 value 13.880241
## final  value 13.880241
## stopped after 100 iterations
## # weights:  109
## initial  value 127.203182
## iter  10 value 37.243661
## iter  20 value 18.640389
```

```
## iter  30 value 15.532234
## iter  40 value 14.858259
## iter  50 value 14.469639
## iter  60 value 14.331636
## iter  70 value 14.243247
## iter  80 value 14.234951
## iter  90 value 14.234158
## iter 100 value 14.234100
## final  value 14.234100
## stopped after 100 iterations
## # weights:  127
## initial  value 133.128679
## iter  10 value 21.186800
## iter  20 value 14.932711
## iter  30 value 13.941914
## iter  40 value 13.573896
## iter  50 value 13.476388
## iter  60 value 13.453491
## iter  70 value 13.447734
## iter  80 value 13.440544
## iter  90 value 13.437822
## iter 100 value 13.434634
## final  value 13.434634
## stopped after 100 iterations
## # weights:  145
## initial  value 142.182858
## iter  10 value 32.462386
## iter  20 value 17.563943
## iter  30 value 14.454188
## iter  40 value 13.874216
## iter  50 value 13.531798
## iter  60 value 13.421635
## iter  70 value 13.361604
## iter  80 value 13.354242
## iter  90 value 13.331635
## iter 100 value 13.311480
## final  value 13.311480
## stopped after 100 iterations
## # weights:  163
## initial  value 122.973254
## iter  10 value 34.437521
## iter  20 value 17.657678
## iter  30 value 14.530163
## iter  40 value 13.758371
## iter  50 value 13.502587
## iter  60 value 13.432879
## iter  70 value 13.408832
## iter  80 value 13.403192
## iter  90 value 13.402869
## iter 100 value 13.402840
## final  value 13.402840
## stopped after 100 iterations
## # weights:  181
## initial  value 120.704677
```

```
## iter  10 value 23.213217
## iter  20 value 15.837372
## iter  30 value 13.960615
## iter  40 value 13.498637
## iter  50 value 13.313719
## iter  60 value 13.256127
## iter  70 value 13.210562
## iter  80 value 13.200699
## iter  90 value 13.195445
## iter 100 value 13.190204
## final  value 13.190204
## stopped after 100 iterations
## # weights:  199
## initial  value 124.413395
## iter  10 value 21.874065
## iter  20 value 15.005361
## iter  30 value 13.875317
## iter  40 value 13.616517
## iter  50 value 13.452372
## iter  60 value 13.334126
## iter  70 value 13.282405
## iter  80 value 13.224638
## iter  90 value 13.214846
## iter 100 value 13.212357
## final  value 13.212357
## stopped after 100 iterations
## # weights:  217
## initial  value 118.962479
## iter  10 value 26.806464
## iter  20 value 17.559326
## iter  30 value 15.006359
## iter  40 value 13.494655
## iter  50 value 13.237953
## iter  60 value 13.188683
## iter  70 value 13.097609
## iter  80 value 13.074646
## iter  90 value 13.072342
## iter 100 value 13.052708
## final  value 13.052708
## stopped after 100 iterations
## # weights:  235
## initial  value 133.703372
## iter  10 value 36.641827
## iter  20 value 19.118232
## iter  30 value 14.648545
## iter  40 value 13.716138
## iter  50 value 13.451571
## iter  60 value 13.274959
## iter  70 value 13.208330
## iter  80 value 13.197645
## iter  90 value 13.194747
## iter 100 value 13.194265
## final  value 13.194265
## stopped after 100 iterations
```

```
## # weights:  253
## initial  value 142.255468
## iter  10 value 24.886574
## iter  20 value 16.597788
## iter  30 value 14.054671
## iter  40 value 13.512198
## iter  50 value 13.253267
## iter  60 value 13.203268
## iter  70 value 13.181974
## iter  80 value 13.178603
## iter  90 value 13.175574
## iter 100 value 13.173859
## final  value 13.173859
## stopped after 100 iterations
## # weights:  271
## initial  value 136.897677
## iter  10 value 33.133577
## iter  20 value 18.670373
## iter  30 value 14.888459
## iter  40 value 13.922340
## iter  50 value 13.651478
## iter  60 value 13.287214
## iter  70 value 13.162235
## iter  80 value 13.119435
## iter  90 value 13.101899
## iter 100 value 13.098981
## final  value 13.098981
## stopped after 100 iterations
## # weights:  289
## initial  value 170.640420
## iter  10 value 20.893458
## iter  20 value 14.609686
## iter  30 value 13.657727
## iter  40 value 13.265182
## iter  50 value 13.202522
## iter  60 value 13.185310
## iter  70 value 13.181776
## iter  80 value 13.174702
## iter  90 value 13.169925
## iter 100 value 13.167365
## final  value 13.167365
## stopped after 100 iterations
## # weights:  307
## initial  value 139.262216
## iter  10 value 26.989185
## iter  20 value 16.485531
## iter  30 value 13.919927
## iter  40 value 13.561649
## iter  50 value 13.280255
## iter  60 value 13.177258
## iter  70 value 13.095750
## iter  80 value 13.069802
## iter  90 value 13.057708
## iter 100 value 13.052480
```

```
## final  value 13.052480
## stopped after 100 iterations
## # weights:  325
## initial  value 125.022151
## iter  10 value 19.038699
## iter  20 value 14.340758
## iter  30 value 13.468859
## iter  40 value 13.290136
## iter  50 value 13.198733
## iter  60 value 13.182138
## iter  70 value 13.159526
## iter  80 value 13.130910
## iter  90 value 13.117236
## iter 100 value 13.110148
## final  value 13.110148
## stopped after 100 iterations
## # weights:  19
## initial  value 131.143630
## iter  10 value 51.305426
## iter  20 value 33.202677
## iter  30 value 31.249713
## iter  40 value 30.959167
## iter  50 value 30.959091
## final  value 30.959090
## converged
## # weights:  37
## initial  value 116.076562
## iter  10 value 38.336518
## iter  20 value 28.302005
## iter  30 value 25.606118
## iter  40 value 25.547777
## final  value 25.547746
## converged
## # weights:  55
## initial  value 121.613197
## iter  10 value 32.970020
## iter  20 value 26.138837
## iter  30 value 23.893013
## iter  40 value 23.668700
## iter  50 value 23.410360
## iter  60 value 23.399906
## iter  70 value 23.398527
## final  value 23.398526
## converged
## # weights:  73
## initial  value 118.631035
## iter  10 value 35.788589
## iter  20 value 24.582517
## iter  30 value 22.044002
## iter  40 value 21.304875
## iter  50 value 21.153133
## iter  60 value 21.122367
## iter  70 value 21.119629
## iter  80 value 21.119559
```

```
## final  value 21.119559
## converged
## # weights:  91
## initial  value 117.797013
## iter  10 value 36.098658
## iter  20 value 23.602513
## iter  30 value 22.259434
## iter  40 value 21.632286
## iter  50 value 21.473573
## iter  60 value 21.455235
## iter  70 value 21.452223
## final  value 21.452190
## converged
## # weights:  109
## initial  value 132.532498
## iter  10 value 27.830754
## iter  20 value 21.322329
## iter  30 value 20.715961
## iter  40 value 20.629926
## iter  50 value 20.345974
## iter  60 value 20.304364
## iter  70 value 20.294406
## iter  80 value 20.294274
## final  value 20.294265
## converged
## # weights:  127
## initial  value 114.822028
## iter  10 value 25.985151
## iter  20 value 22.349187
## iter  30 value 21.299525
## iter  40 value 20.479746
## iter  50 value 20.307891
## iter  60 value 20.280485
## iter  70 value 20.278237
## iter  80 value 20.278047
## iter  90 value 20.278015
## final  value 20.278007
## converged
## # weights:  145
## initial  value 108.056592
## iter  10 value 26.574140
## iter  20 value 22.187487
## iter  30 value 20.732316
## iter  40 value 20.323006
## iter  50 value 20.250113
## iter  60 value 20.242831
## iter  70 value 20.241546
## iter  80 value 20.241506
## final  value 20.241505
## converged
## # weights:  163
## initial  value 134.442575
## iter  10 value 27.125397
## iter  20 value 21.687228
```

```
## iter  30 value 20.842037
## iter  40 value 20.396856
## iter  50 value 20.135269
## iter  60 value 20.098737
## iter  70 value 20.086653
## iter  80 value 20.084647
## iter  90 value 20.084522
## iter 100 value 20.084503
## final  value 20.084503
## stopped after 100 iterations
## # weights:  181
## initial  value 148.273356
## iter  10 value 29.354129
## iter  20 value 21.658511
## iter  30 value 20.661131
## iter  40 value 20.315691
## iter  50 value 20.243732
## iter  60 value 20.175322
## iter  70 value 20.125847
## iter  80 value 20.089769
## iter  90 value 20.079062
## iter 100 value 20.077575
## final  value 20.077575
## stopped after 100 iterations
## # weights:  199
## initial  value 137.650270
## iter  10 value 31.223100
## iter  20 value 21.544733
## iter  30 value 20.907196
## iter  40 value 20.274552
## iter  50 value 20.174564
## iter  60 value 20.101481
## iter  70 value 20.074567
## iter  80 value 20.063539
## iter  90 value 20.055247
## iter 100 value 20.050021
## final  value 20.050021
## stopped after 100 iterations
## # weights:  217
## initial  value 133.987003
## iter  10 value 33.737858
## iter  20 value 22.192533
## iter  30 value 20.734619
## iter  40 value 20.289456
## iter  50 value 20.146684
## iter  60 value 20.107231
## iter  70 value 20.052102
## iter  80 value 20.002069
## iter  90 value 19.991974
## iter 100 value 19.990205
## final  value 19.990205
## stopped after 100 iterations
## # weights:  235
## initial  value 121.538236
```

```
## iter  10 value 27.174955
## iter  20 value 22.072984
## iter  30 value 21.009172
## iter  40 value 20.532386
## iter  50 value 20.242229
## iter  60 value 20.156815
## iter  70 value 20.140405
## iter  80 value 20.121831
## iter  90 value 20.110721
## iter 100 value 20.108307
## final  value 20.108307
## stopped after 100 iterations
## # weights:  253
## initial  value 147.053397
## iter  10 value 28.336766
## iter  20 value 21.664163
## iter  30 value 20.671414
## iter  40 value 20.381949
## iter  50 value 20.068612
## iter  60 value 19.986141
## iter  70 value 19.953084
## iter  80 value 19.937839
## iter  90 value 19.935508
## iter 100 value 19.935315
## final  value 19.935315
## stopped after 100 iterations
## # weights:  271
## initial  value 141.293574
## iter  10 value 33.878198
## iter  20 value 21.836897
## iter  30 value 20.728056
## iter  40 value 20.354424
## iter  50 value 20.255237
## iter  60 value 20.161050
## iter  70 value 20.111513
## iter  80 value 20.058339
## iter  90 value 20.043121
## iter 100 value 20.027590
## final  value 20.027590
## stopped after 100 iterations
## # weights:  289
## initial  value 143.510605
## iter  10 value 24.823014
## iter  20 value 20.777214
## iter  30 value 20.294607
## iter  40 value 20.125993
## iter  50 value 20.072491
## iter  60 value 20.053723
## iter  70 value 20.043103
## iter  80 value 20.040994
## iter  90 value 20.040293
## iter 100 value 20.039984
## final  value 20.039984
## stopped after 100 iterations
```

```
## # weights:  307
## initial  value 170.650722
## iter  10 value 32.038553
## iter  20 value 21.656090
## iter  30 value 20.486057
## iter  40 value 20.142803
## iter  50 value 20.084035
## iter  60 value 20.072564
## iter  70 value 20.060594
## iter  80 value 20.040469
## iter  90 value 20.029789
## iter 100 value 20.022911
## final  value 20.022911
## stopped after 100 iterations
## # weights:  325
## initial  value 131.408518
## iter  10 value 34.130360
## iter  20 value 22.367207
## iter  30 value 20.517729
## iter  40 value 20.287215
## iter  50 value 20.205754
## iter  60 value 20.174391
## iter  70 value 20.111290
## iter  80 value 20.086616
## iter  90 value 20.037545
## iter 100 value 20.009215
## final  value 20.009215
## stopped after 100 iterations
## # weights:  19
## initial  value 116.745794
## iter  10 value 33.988450
## iter  20 value 18.235007
## iter  30 value 13.301081
## iter  40 value 13.119546
## iter  50 value 13.068965
## iter  60 value 13.056854
## iter  70 value 13.054272
## iter  80 value 13.052427
## iter  90 value 13.051440
## iter 100 value 13.051140
## final  value 13.051140
## stopped after 100 iterations
## # weights:  37
## initial  value 112.896951
## iter  10 value 26.910545
## iter  20 value 14.576151
## iter  30 value 11.836746
## iter  40 value 11.232683
## iter  50 value 10.037924
## iter  60 value 8.568235
## iter  70 value 7.437884
## iter  80 value 3.848839
## iter  90 value 2.295413
## iter 100 value 2.267745
```

```
## final  value 2.267745
## stopped after 100 iterations
## # weights:  55
## initial  value 135.584989
## iter  10 value 24.683986
## iter  20 value 5.511843
## iter  30 value 2.737519
## iter  40 value 2.703774
## iter  50 value 2.703531
## iter  60 value 2.703414
## iter  70 value 2.703377
## final  value 2.703373
## converged
## # weights:  73
## initial  value 126.098363
## iter  10 value 16.959836
## iter  20 value 3.448912
## iter  30 value 2.255831
## iter  40 value 2.249789
## iter  50 value 2.249341
## iter  50 value 2.249341
## iter  50 value 2.249341
## final  value 2.249341
## converged
## # weights:  91
## initial  value 137.486329
## iter  10 value 15.611652
## iter  20 value 1.125794
## iter  30 value 0.005522
## iter  40 value 0.000109
## iter  40 value 0.000038
## iter  40 value 0.000036
## final  value 0.000036
## converged
## # weights:  109
## initial  value 129.096577
## iter  10 value 11.985432
## iter  20 value 0.341350
## iter  30 value 0.006421
## iter  40 value 0.001713
## iter  50 value 0.000111
## iter  50 value 0.000083
## iter  50 value 0.000082
## final  value 0.000082
## converged
## # weights:  127
## initial  value 127.778937
## iter  10 value 11.467383
## iter  20 value 0.140480
## iter  30 value 0.001286
## iter  40 value 0.000233
## final  value 0.000083
## converged
## # weights:  145
```

```
## initial  value 125.518452
## iter  10 value 9.926685
## iter  20 value 0.491318
## iter  30 value 0.010866
## iter  40 value 0.001847
## iter  50 value 0.000664
## iter  60 value 0.000139
## iter  60 value 0.000082
## iter  60 value 0.000081
## final  value 0.000081
## converged
## # weights:  163
## initial  value 112.005468
## iter  10 value 11.689282
## iter  20 value 0.680470
## iter  30 value 0.006107
## iter  40 value 0.000517
## final  value 0.000095
## converged
## # weights:  181
## initial  value 132.923760
## iter  10 value 14.909484
## iter  20 value 0.487099
## iter  30 value 0.010204
## iter  40 value 0.001200
## iter  50 value 0.000258
## iter  60 value 0.000225
## iter  70 value 0.000153
## final  value 0.000089
## converged
## # weights:  199
## initial  value 129.647011
## iter  10 value 14.798582
## iter  20 value 1.680650
## iter  30 value 0.014629
## iter  40 value 0.000706
## final  value 0.000088
## converged
## # weights:  217
## initial  value 126.071091
## iter  10 value 10.291925
## iter  20 value 0.239293
## iter  30 value 0.006310
## iter  40 value 0.000315
## final  value 0.000087
## converged
## # weights:  235
## initial  value 143.296985
## iter  10 value 16.064190
## iter  20 value 0.690599
## iter  30 value 0.016193
## iter  40 value 0.001865
## final  value 0.000069
## converged
```

```
## # weights:  253
## initial  value 154.737244
## iter  10 value 13.239602
## iter  20 value 0.171343
## iter  30 value 0.002331
## iter  40 value 0.000124
## iter  40 value 0.000087
## iter  40 value 0.000087
## final  value 0.000087
## converged
## # weights:  271
## initial  value 155.744147
## iter  10 value 13.686471
## iter  20 value 0.870829
## iter  30 value 0.011448
## iter  40 value 0.001592
## iter  50 value 0.000441
## final  value 0.000098
## converged
## # weights:  289
## initial  value 115.176384
## iter  10 value 11.199782
## iter  20 value 0.367007
## iter  30 value 0.004804
## iter  40 value 0.000815
## iter  50 value 0.000383
## final  value 0.000027
## converged
## # weights:  307
## initial  value 120.945484
## iter  10 value 12.675465
## iter  20 value 0.185154
## iter  30 value 0.001083
## final  value 0.000098
## converged
## # weights:  325
## initial  value 128.990052
## iter  10 value 7.869884
## iter  20 value 0.241597
## iter  30 value 0.003109
## iter  40 value 0.000398
## final  value 0.000039
## converged
## # weights:  19
## initial  value 120.362521
## iter  10 value 37.802548
## iter  20 value 23.249174
## iter  30 value 22.827778
## final  value 22.827471
## converged
## # weights:  37
## initial  value 117.050941
## iter  10 value 33.677635
## iter  20 value 23.417143
```

```
## iter  30 value 19.080360
## iter  40 value 15.928422
## iter  50 value 15.871162
## final  value 15.871083
## converged
## # weights:  55
## initial  value 119.817401
## iter  10 value 31.585074
## iter  20 value 21.851176
## iter  30 value 17.340909
## iter  40 value 16.248939
## iter  50 value 16.152877
## iter  60 value 16.137172
## iter  70 value 16.135787
## iter  80 value 16.135743
## final  value 16.135743
## converged
## # weights:  73
## initial  value 122.462362
## iter  10 value 26.612489
## iter  20 value 20.254782
## iter  30 value 16.707365
## iter  40 value 14.674381
## iter  50 value 14.526932
## iter  60 value 14.467186
## iter  70 value 14.392657
## iter  80 value 14.361474
## iter  90 value 14.225310
## iter 100 value 14.173510
## final  value 14.173510
## stopped after 100 iterations
## # weights:  91
## initial  value 119.976608
## iter  10 value 23.337153
## iter  20 value 15.287481
## iter  30 value 14.028915
## iter  40 value 13.644773
## iter  50 value 13.499023
## iter  60 value 13.461664
## iter  70 value 13.460198
## iter  80 value 13.460181
## final  value 13.460180
## converged
## # weights:  109
## initial  value 124.827214
## iter  10 value 22.777484
## iter  20 value 15.433936
## iter  30 value 14.219203
## iter  40 value 14.045152
## iter  50 value 13.968197
## iter  60 value 13.958257
## iter  70 value 13.954621
## iter  80 value 13.954278
## iter  90 value 13.954054
```

```
## final  value 13.954050
## converged
## # weights:  127
## initial  value 125.361167
## iter  10 value 19.704911
## iter  20 value 14.875415
## iter  30 value 14.274816
## iter  40 value 14.128106
## iter  50 value 14.097184
## iter  60 value 14.092377
## iter  70 value 14.090628
## iter  80 value 14.090463
## iter  90 value 14.090161
## iter 100 value 14.089888
## final  value 14.089888
## stopped after 100 iterations
## # weights:  145
## initial  value 114.835395
## iter  10 value 19.964038
## iter  20 value 15.156690
## iter  30 value 13.465901
## iter  40 value 13.133522
## iter  50 value 13.049500
## iter  60 value 13.020691
## iter  70 value 13.015223
## iter  80 value 13.014226
## iter  90 value 13.014055
## iter 100 value 13.013776
## final  value 13.013776
## stopped after 100 iterations
## # weights:  163
## initial  value 129.837485
## iter  10 value 18.490256
## iter  20 value 14.121019
## iter  30 value 13.236880
## iter  40 value 12.911939
## iter  50 value 12.823234
## iter  60 value 12.793404
## iter  70 value 12.776360
## iter  80 value 12.771449
## iter  90 value 12.770889
## iter 100 value 12.770713
## final  value 12.770713
## stopped after 100 iterations
## # weights:  181
## initial  value 108.064880
## iter  10 value 18.103763
## iter  20 value 13.633064
## iter  30 value 13.024724
## iter  40 value 12.827623
## iter  50 value 12.784826
## iter  60 value 12.775141
## iter  70 value 12.772888
## iter  80 value 12.772136
```

```
## iter  90 value 12.771871
## final  value 12.771861
## converged
## # weights:  199
## initial  value 203.983468
## iter  10 value 22.574385
## iter  20 value 15.038460
## iter  30 value 13.372913
## iter  40 value 13.023981
## iter  50 value 12.960881
## iter  60 value 12.927716
## iter  70 value 12.867353
## iter  80 value 12.786633
## iter  90 value 12.763298
## iter 100 value 12.739480
## final  value 12.739480
## stopped after 100 iterations
## # weights:  217
## initial  value 118.495245
## iter  10 value 19.460153
## iter  20 value 14.486880
## iter  30 value 13.234005
## iter  40 value 12.914963
## iter  50 value 12.831712
## iter  60 value 12.811406
## iter  70 value 12.806213
## iter  80 value 12.796732
## iter  90 value 12.766419
## iter 100 value 12.731407
## final  value 12.731407
## stopped after 100 iterations
## # weights:  235
## initial  value 115.848665
## iter  10 value 19.997457
## iter  20 value 13.837555
## iter  30 value 13.021717
## iter  40 value 12.735091
## iter  50 value 12.701116
## iter  60 value 12.674038
## iter  70 value 12.667086
## iter  80 value 12.660932
## iter  90 value 12.657370
## iter 100 value 12.656403
## final  value 12.656403
## stopped after 100 iterations
## # weights:  253
## initial  value 117.830168
## iter  10 value 19.792712
## iter  20 value 14.149249
## iter  30 value 13.060710
## iter  40 value 12.761212
## iter  50 value 12.695317
## iter  60 value 12.649177
## iter  70 value 12.638890
```

```
## iter  80 value 12.633864
## iter  90 value 12.632947
## iter 100 value 12.632864
## final  value 12.632864
## stopped after 100 iterations
## # weights:  271
## initial  value 113.692507
## iter  10 value 35.970776
## iter  20 value 18.537860
## iter  30 value 14.008532
## iter  40 value 13.146383
## iter  50 value 12.896867
## iter  60 value 12.822007
## iter  70 value 12.776493
## iter  80 value 12.712718
## iter  90 value 12.692218
## iter 100 value 12.668276
## final  value 12.668276
## stopped after 100 iterations
## # weights:  289
## initial  value 151.053290
## iter  10 value 20.375199
## iter  20 value 14.268268
## iter  30 value 13.178069
## iter  40 value 12.922386
## iter  50 value 12.862293
## iter  60 value 12.826991
## iter  70 value 12.735198
## iter  80 value 12.711556
## iter  90 value 12.699852
## iter 100 value 12.698520
## final  value 12.698520
## stopped after 100 iterations
## # weights:  307
## initial  value 123.934630
## iter  10 value 20.191693
## iter  20 value 14.159672
## iter  30 value 13.031338
## iter  40 value 12.694815
## iter  50 value 12.641398
## iter  60 value 12.630227
## iter  70 value 12.626766
## iter  80 value 12.625128
## iter  90 value 12.624581
## iter 100 value 12.623880
## final  value 12.623880
## stopped after 100 iterations
## # weights:  325
## initial  value 171.223470
## iter  10 value 25.552675
## iter  20 value 15.322630
## iter  30 value 13.268773
## iter  40 value 12.887970
## iter  50 value 12.737534
```

```
## iter  60 value 12.698537
## iter  70 value 12.674585
## iter  80 value 12.655252
## iter  90 value 12.641754
## iter 100 value 12.629413
## final  value 12.629413
## stopped after 100 iterations
## # weights:  19
## initial  value 122.586676
## iter  10 value 59.494898
## iter  20 value 33.588670
## iter  30 value 28.965904
## final  value 28.951952
## converged
## # weights:  37
## initial  value 120.882231
## iter  10 value 34.640454
## iter  20 value 25.221964
## iter  30 value 23.814078
## iter  40 value 23.600594
## iter  50 value 23.586626
## final  value 23.586616
## converged
## # weights:  55
## initial  value 126.295955
## iter  10 value 30.113685
## iter  20 value 24.904335
## iter  30 value 22.402643
## iter  40 value 21.763018
## iter  50 value 21.730923
## iter  60 value 21.728974
## final  value 21.728973
## converged
## # weights:  73
## initial  value 117.236522
## iter  10 value 24.534915
## iter  20 value 22.367438
## iter  30 value 21.330425
## iter  40 value 21.051972
## iter  50 value 21.023348
## iter  60 value 21.020110
## final  value 21.020014
## converged
## # weights:  91
## initial  value 156.674395
## iter  10 value 27.357745
## iter  20 value 20.923766
## iter  30 value 20.131323
## iter  40 value 20.067700
## iter  50 value 20.060694
## iter  60 value 20.059069
## iter  70 value 20.059029
## final  value 20.059028
## converged
```

```
## # weights:  109
## initial  value 123.048791
## iter  10 value 27.249907
## iter  20 value 21.769264
## iter  30 value 20.761693
## iter  40 value 20.266155
## iter  50 value 20.087081
## iter  60 value 20.045598
## iter  70 value 20.022291
## iter  80 value 20.014818
## iter  90 value 20.013433
## iter 100 value 20.013362
## final  value 20.013362
## stopped after 100 iterations
## # weights:  127
## initial  value 139.296579
## iter  10 value 30.539043
## iter  20 value 21.806780
## iter  30 value 20.782529
## iter  40 value 20.467844
## iter  50 value 19.868444
## iter  60 value 19.806697
## iter  70 value 19.791803
## iter  80 value 19.787520
## iter  90 value 19.787142
## iter 100 value 19.787052
## final  value 19.787052
## stopped after 100 iterations
## # weights:  145
## initial  value 121.743415
## iter  10 value 45.104776
## iter  20 value 22.570705
## iter  30 value 20.247014
## iter  40 value 19.845902
## iter  50 value 19.736719
## iter  60 value 19.659460
## iter  70 value 19.630299
## iter  80 value 19.624633
## iter  90 value 19.623406
## iter 100 value 19.621918
## final  value 19.621918
## stopped after 100 iterations
## # weights:  163
## initial  value 128.025353
## iter  10 value 25.508577
## iter  20 value 20.358290
## iter  30 value 19.860405
## iter  40 value 19.671763
## iter  50 value 19.570970
## iter  60 value 19.555372
## iter  70 value 19.554632
## iter  80 value 19.552174
## iter  90 value 19.548520
## iter 100 value 19.539258
```

```
## final  value 19.539258
## stopped after 100 iterations
## # weights:  181
## initial  value 124.484732
## iter  10 value 24.983636
## iter  20 value 19.935269
## iter  30 value 19.550841
## iter  40 value 19.417354
## iter  50 value 19.382785
## iter  60 value 19.379600
## iter  70 value 19.378475
## iter  80 value 19.378150
## iter  90 value 19.377823
## iter 100 value 19.377756
## final  value 19.377756
## stopped after 100 iterations
## # weights:  199
## initial  value 110.070541
## iter  10 value 41.196991
## iter  20 value 20.910591
## iter  30 value 19.550673
## iter  40 value 19.408357
## iter  50 value 19.367861
## iter  60 value 19.359522
## iter  70 value 19.355267
## iter  80 value 19.347539
## iter  90 value 19.345802
## iter 100 value 19.345010
## final  value 19.345010
## stopped after 100 iterations
## # weights:  217
## initial  value 145.758903
## iter  10 value 33.644551
## iter  20 value 22.818317
## iter  30 value 19.949225
## iter  40 value 19.508845
## iter  50 value 19.388334
## iter  60 value 19.329663
## iter  70 value 19.311281
## iter  80 value 19.304975
## iter  90 value 19.303636
## iter 100 value 19.303319
## final  value 19.303319
## stopped after 100 iterations
## # weights:  235
## initial  value 114.122431
## iter  10 value 24.684195
## iter  20 value 20.009724
## iter  30 value 19.676335
## iter  40 value 19.413051
## iter  50 value 19.372544
## iter  60 value 19.355737
## iter  70 value 19.347498
## iter  80 value 19.344946
```

```
## iter  90 value 19.342424
## iter 100 value 19.339790
## final  value 19.339790
## stopped after 100 iterations
## # weights:  253
## initial  value 125.421446
## iter  10 value 28.765096
## iter  20 value 21.755921
## iter  30 value 20.355416
## iter  40 value 19.672272
## iter  50 value 19.413636
## iter  60 value 19.367702
## iter  70 value 19.332183
## iter  80 value 19.300102
## iter  90 value 19.284494
## iter 100 value 19.283012
## final  value 19.283012
## stopped after 100 iterations
## # weights:  271
## initial  value 105.960031
## iter  10 value 26.220721
## iter  20 value 20.916818
## iter  30 value 19.959001
## iter  40 value 19.568015
## iter  50 value 19.426661
## iter  60 value 19.373060
## iter  70 value 19.335390
## iter  80 value 19.317353
## iter  90 value 19.290931
## iter 100 value 19.284084
## final  value 19.284084
## stopped after 100 iterations
## # weights:  289
## initial  value 169.752343
## iter  10 value 26.496041
## iter  20 value 20.460343
## iter  30 value 19.756675
## iter  40 value 19.433145
## iter  50 value 19.375746
## iter  60 value 19.317071
## iter  70 value 19.308522
## iter  80 value 19.292718
## iter  90 value 19.288070
## iter 100 value 19.217416
## final  value 19.217416
## stopped after 100 iterations
## # weights:  307
## initial  value 174.675041
## iter  10 value 25.159273
## iter  20 value 20.155379
## iter  30 value 19.544097
## iter  40 value 19.407706
## iter  50 value 19.338797
## iter  60 value 19.318545
```

```
## iter  70 value 19.297608
## iter  80 value 19.267774
## iter  90 value 19.210909
## iter 100 value 19.204517
## final  value 19.204517
## stopped after 100 iterations
## # weights:  325
## initial  value 128.854450
## iter  10 value 27.112416
## iter  20 value 20.013318
## iter  30 value 19.425978
## iter  40 value 19.336363
## iter  50 value 19.292562
## iter  60 value 19.276829
## iter  70 value 19.265366
## iter  80 value 19.264610
## iter  90 value 19.264290
## iter 100 value 19.264193
## final  value 19.264193
## stopped after 100 iterations
## # weights:  19
## initial  value 123.484887
## iter  10 value 28.672912
## iter  20 value 19.116869
## iter  30 value 13.981644
## iter  40 value 9.538329
## iter  50 value 9.512547
## iter  60 value 9.491688
## iter  70 value 9.483088
## iter  80 value 9.481121
## iter  90 value 9.480603
## iter 100 value 9.480015
## final  value 9.480015
## stopped after 100 iterations
## # weights:  37
## initial  value 118.993921
## iter  10 value 28.126566
## iter  20 value 10.601028
## iter  30 value 3.868596
## iter  40 value 2.894655
## iter  50 value 2.871658
## iter  60 value 2.870839
## iter  70 value 2.870815
## iter  70 value 2.870815
## iter  70 value 2.870815
## final  value 2.870815
## converged
## # weights:  55
## initial  value 111.098317
## iter  10 value 21.084203
## iter  20 value 8.000463
## iter  30 value 3.666210
## iter  40 value 2.774712
## iter  50 value 2.772967
```

```
## iter  60 value 2.772676
## iter  70 value 2.772590
## final  value 2.772589
## converged
## # weights:  73
## initial  value 110.982121
## iter  10 value 20.447974
## iter  20 value 8.045657
## iter  30 value 2.002057
## iter  40 value 0.163282
## iter  50 value 0.015782
## iter  60 value 0.003714
## iter  70 value 0.001929
## iter  80 value 0.000552
## iter  90 value 0.000204
## final  value 0.000079
## converged
## # weights:  91
## initial  value 128.600997
## iter  10 value 13.337391
## iter  20 value 2.844466
## iter  30 value 0.009718
## final  value 0.000085
## converged
## # weights:  109
## initial  value 117.296839
## iter  10 value 11.780723
## iter  20 value 0.651497
## iter  30 value 0.003265
## iter  40 value 0.000373
## final  value 0.000092
## converged
## # weights:  127
## initial  value 115.793765
## iter  10 value 15.774408
## iter  20 value 3.436376
## iter  30 value 0.224029
## iter  40 value 0.036956
## iter  50 value 0.006579
## iter  60 value 0.000918
## iter  70 value 0.000640
## iter  80 value 0.000193
## final  value 0.000046
## converged
## # weights:  145
## initial  value 121.758511
## iter  10 value 18.778770
## iter  20 value 0.873230
## iter  30 value 0.018786
## iter  40 value 0.000898
## iter  50 value 0.000124
## final  value 0.000093
## converged
## # weights:  163
```

```
## initial  value 101.589472
## iter  10 value 12.572370
## iter  20 value 1.041586
## iter  30 value 0.022849
## iter  40 value 0.003645
## iter  50 value 0.000392
## iter  60 value 0.000266
## final  value 0.000090
## converged
## # weights:  181
## initial  value 119.646281
## iter  10 value 11.756154
## iter  20 value 0.320040
## iter  30 value 0.005962
## iter  40 value 0.000210
## final  value 0.000088
## converged
## # weights:  199
## initial  value 111.042805
## iter  10 value 11.276431
## iter  20 value 0.210479
## iter  30 value 0.001355
## iter  40 value 0.000379
## iter  50 value 0.000199
## final  value 0.000066
## converged
## # weights:  217
## initial  value 140.960879
## iter  10 value 13.790286
## iter  20 value 3.265831
## iter  30 value 2.878724
## iter  40 value 2.661882
## iter  50 value 1.902136
## iter  60 value 0.681428
## iter  70 value 0.063375
## iter  80 value 0.032272
## iter  90 value 0.009850
## iter 100 value 0.005502
## final  value 0.005502
## stopped after 100 iterations
## # weights:  235
## initial  value 140.184521
## iter  10 value 12.727218
## iter  20 value 0.147721
## iter  30 value 0.002552
## iter  40 value 0.000230
## final  value 0.000084
## converged
## # weights:  253
## initial  value 151.058395
## iter  10 value 13.885080
## iter  20 value 0.130782
## iter  30 value 0.000978
## final  value 0.000051
```

```
## converged
## # weights:  271
## initial  value 127.275726
## iter  10 value 14.760364
## iter  20 value 0.418511
## iter  30 value 0.004110
## iter  40 value 0.000435
## iter  50 value 0.000171
## final  value 0.000070
## converged
## # weights:  289
## initial  value 140.328253
## iter  10 value 14.788631
## iter  20 value 0.821823
## iter  30 value 0.006356
## iter  40 value 0.000815
## final  value 0.000060
## converged
## # weights:  307
## initial  value 153.467838
## iter  10 value 15.985911
## iter  20 value 0.492140
## iter  30 value 0.016699
## iter  40 value 0.001200
## iter  50 value 0.000262
## iter  60 value 0.000153
## final  value 0.000062
## converged
## # weights:  325
## initial  value 183.765841
## iter  10 value 10.638815
## iter  20 value 0.815175
## iter  30 value 0.019201
## iter  40 value 0.000831
## iter  50 value 0.000242
## iter  60 value 0.000110
## final  value 0.000098
## converged
## # weights:  19
## initial  value 118.676858
## iter  10 value 28.952944
## iter  20 value 25.071505
## iter  30 value 25.050716
## final  value 25.050681
## converged
## # weights:  37
## initial  value 115.129672
## iter  10 value 30.244817
## iter  20 value 25.321949
## iter  30 value 19.170748
## iter  40 value 17.854210
## iter  50 value 17.540384
## iter  60 value 17.037362
## iter  70 value 16.920537
```

```
## final  value 16.919111
## converged
## # weights:  55
## initial  value 116.701814
## iter  10 value 28.998897
## iter  20 value 23.184859
## iter  30 value 18.633800
## iter  40 value 16.797040
## iter  50 value 16.587390
## iter  60 value 16.343472
## iter  70 value 16.258364
## iter  80 value 16.241554
## iter  90 value 16.241116
## final  value 16.241115
## converged
## # weights:  73
## initial  value 116.995634
## iter  10 value 24.603674
## iter  20 value 15.466521
## iter  30 value 14.085592
## iter  40 value 13.966264
## iter  50 value 13.959878
## iter  60 value 13.952258
## iter  70 value 13.942636
## iter  80 value 13.939767
## final  value 13.939742
## converged
## # weights:  91
## initial  value 118.379736
## iter  10 value 26.814347
## iter  20 value 16.468471
## iter  30 value 15.027055
## iter  40 value 14.175907
## iter  50 value 13.884397
## iter  60 value 13.661518
## iter  70 value 13.540985
## iter  80 value 13.437786
## iter  90 value 13.388304
## iter 100 value 13.365212
## final  value 13.365212
## stopped after 100 iterations
## # weights:  109
## initial  value 141.137088
## iter  10 value 28.169406
## iter  20 value 15.929020
## iter  30 value 14.023283
## iter  40 value 13.530237
## iter  50 value 13.261936
## iter  60 value 13.050304
## iter  70 value 13.001047
## iter  80 value 12.989853
## iter  90 value 12.988384
## iter 100 value 12.988329
## final  value 12.988329
```

```
## stopped after 100 iterations
## # weights:  127
## initial  value 112.977662
## iter  10 value 22.017102
## iter  20 value 15.417199
## iter  30 value 14.245184
## iter  40 value 13.963620
## iter  50 value 13.794418
## iter  60 value 13.765007
## iter  70 value 13.706347
## iter  80 value 13.499396
## iter  90 value 13.331776
## iter 100 value 13.293411
## final  value 13.293411
## stopped after 100 iterations
## # weights:  145
## initial  value 125.783918
## iter  10 value 32.080151
## iter  20 value 15.865831
## iter  30 value 14.243843
## iter  40 value 13.716363
## iter  50 value 13.259740
## iter  60 value 12.897632
## iter  70 value 12.704877
## iter  80 value 12.645519
## iter  90 value 12.632492
## iter 100 value 12.629493
## final  value 12.629493
## stopped after 100 iterations
## # weights:  163
## initial  value 130.787430
## iter  10 value 24.444351
## iter  20 value 15.960628
## iter  30 value 13.649621
## iter  40 value 13.138582
## iter  50 value 12.903947
## iter  60 value 12.809710
## iter  70 value 12.765551
## iter  80 value 12.730359
## iter  90 value 12.609833
## iter 100 value 12.458936
## final  value 12.458936
## stopped after 100 iterations
## # weights:  181
## initial  value 124.233286
## iter  10 value 20.746893
## iter  20 value 14.352046
## iter  30 value 13.584941
## iter  40 value 13.211971
## iter  50 value 12.935957
## iter  60 value 12.739248
## iter  70 value 12.617680
## iter  80 value 12.585801
## iter  90 value 12.581755
```

```
## iter 100 value 12.580403
## final  value 12.580403
## stopped after 100 iterations
## # weights:  199
## initial  value 126.080586
## iter  10 value 26.502035
## iter  20 value 15.456780
## iter  30 value 13.604896
## iter  40 value 13.210946
## iter  50 value 12.719902
## iter  60 value 12.522889
## iter  70 value 12.491076
## iter  80 value 12.480541
## iter  90 value 12.470858
## iter 100 value 12.453216
## final  value 12.453216
## stopped after 100 iterations
## # weights:  217
## initial  value 155.826642
## iter  10 value 26.803584
## iter  20 value 15.927829
## iter  30 value 13.658120
## iter  40 value 12.957408
## iter  50 value 12.761953
## iter  60 value 12.707586
## iter  70 value 12.697080
## iter  80 value 12.688896
## iter  90 value 12.673958
## iter 100 value 12.670120
## final  value 12.670120
## stopped after 100 iterations
## # weights:  235
## initial  value 171.875361
## iter  10 value 21.296261
## iter  20 value 14.872976
## iter  30 value 13.489888
## iter  40 value 13.105752
## iter  50 value 12.970995
## iter  60 value 12.921560
## iter  70 value 12.865810
## iter  80 value 12.788787
## iter  90 value 12.760465
## iter 100 value 12.727231
## final  value 12.727231
## stopped after 100 iterations
## # weights:  253
## initial  value 117.637322
## iter  10 value 25.976216
## iter  20 value 15.717298
## iter  30 value 13.128674
## iter  40 value 12.600245
## iter  50 value 12.462302
## iter  60 value 12.420195
## iter  70 value 12.405044
```

```
## iter  80 value 12.392738
## iter  90 value 12.388675
## iter 100 value 12.387588
## final  value 12.387588
## stopped after 100 iterations
## # weights:  271
## initial  value 123.619118
## iter  10 value 24.210353
## iter  20 value 14.561092
## iter  30 value 13.047316
## iter  40 value 12.564289
## iter  50 value 12.491723
## iter  60 value 12.469625
## iter  70 value 12.459913
## iter  80 value 12.452610
## iter  90 value 12.445505
## iter 100 value 12.444467
## final  value 12.444467
## stopped after 100 iterations
## # weights:  289
## initial  value 125.411390
## iter  10 value 22.490820
## iter  20 value 14.441297
## iter  30 value 13.387223
## iter  40 value 12.982687
## iter  50 value 12.900778
## iter  60 value 12.850934
## iter  70 value 12.766788
## iter  80 value 12.613010
## iter  90 value 12.532984
## iter 100 value 12.486027
## final  value 12.486027
## stopped after 100 iterations
## # weights:  307
## initial  value 122.558252
## iter  10 value 22.215179
## iter  20 value 15.020273
## iter  30 value 13.551669
## iter  40 value 13.057596
## iter  50 value 12.866684
## iter  60 value 12.689399
## iter  70 value 12.664746
## iter  80 value 12.653976
## iter  90 value 12.648281
## iter 100 value 12.638241
## final  value 12.638241
## stopped after 100 iterations
## # weights:  325
## initial  value 116.151654
## iter  10 value 18.347759
## iter  20 value 13.375392
## iter  30 value 12.649620
## iter  40 value 12.461270
## iter  50 value 12.425445
```

```
## iter  60 value 12.403886
## iter  70 value 12.398398
## iter  80 value 12.389057
## iter  90 value 12.387355
## iter 100 value 12.386137
## final  value 12.386137
## stopped after 100 iterations
## # weights:  19
## initial  value 121.348773
## iter  10 value 32.834161
## iter  20 value 29.642538
## iter  30 value 29.620688
## iter  40 value 29.044662
## iter  50 value 29.023399
## iter  50 value 29.023399
## iter  50 value 29.023399
## final  value 29.023399
## converged
## # weights:  37
## initial  value 120.922589
## iter  10 value 41.002463
## iter  20 value 24.034950
## iter  30 value 23.124428
## iter  40 value 22.991670
## iter  50 value 22.822811
## final  value 22.820481
## converged
## # weights:  55
## initial  value 118.031982
## iter  10 value 30.611301
## iter  20 value 23.143290
## iter  30 value 21.278352
## iter  40 value 20.603710
## iter  50 value 20.599490
## final  value 20.599444
## converged
## # weights:  73
## initial  value 123.851069
## iter  10 value 27.878157
## iter  20 value 22.254902
## iter  30 value 20.939171
## iter  40 value 20.335669
## iter  50 value 20.172468
## iter  60 value 20.153735
## iter  70 value 20.151592
## iter  80 value 20.151237
## iter  80 value 20.151237
## iter  80 value 20.151237
## final  value 20.151237
## converged
## # weights:  91
## initial  value 132.890591
## iter  10 value 30.563357
## iter  20 value 21.339829
```

```
## iter  30 value 20.401129
## iter  40 value 20.247435
## iter  50 value 20.080110
## iter  60 value 20.069829
## iter  70 value 20.069295
## iter  80 value 20.069244
## final  value 20.069243
## converged
## # weights:  109
## initial  value 116.539916
## iter  10 value 26.659844
## iter  20 value 21.307917
## iter  30 value 20.921674
## iter  40 value 20.605060
## iter  50 value 20.293076
## iter  60 value 20.039927
## iter  70 value 19.930406
## iter  80 value 19.922628
## iter  90 value 19.922494
## final  value 19.922491
## converged
## # weights:  127
## initial  value 126.236379
## iter  10 value 25.464275
## iter  20 value 20.486407
## iter  30 value 19.839786
## iter  40 value 19.610602
## iter  50 value 19.485375
## iter  60 value 19.427884
## iter  70 value 19.420217
## iter  80 value 19.418447
## final  value 19.418378
## converged
## # weights:  145
## initial  value 121.400046
## iter  10 value 31.768934
## iter  20 value 20.976011
## iter  30 value 19.950335
## iter  40 value 19.662792
## iter  50 value 19.550639
## iter  60 value 19.498796
## iter  70 value 19.405282
## iter  80 value 19.265640
## iter  90 value 19.262189
## iter 100 value 19.261901
## final  value 19.261901
## stopped after 100 iterations
## # weights:  163
## initial  value 119.161326
## iter  10 value 31.995251
## iter  20 value 21.103676
## iter  30 value 20.211713
## iter  40 value 19.912536
## iter  50 value 19.535099
```

```
## iter  60 value 19.267979
## iter  70 value 19.140831
## iter  80 value 19.067710
## iter  90 value 19.060508
## iter 100 value 19.059406
## final  value 19.059406
## stopped after 100 iterations
## # weights:  181
## initial  value 130.678746
## iter  10 value 31.358203
## iter  20 value 21.304819
## iter  30 value 19.742547
## iter  40 value 19.431609
## iter  50 value 19.299912
## iter  60 value 19.175800
## iter  70 value 19.069067
## iter  80 value 19.054992
## iter  90 value 19.043516
## iter 100 value 19.039741
## final  value 19.039741
## stopped after 100 iterations
## # weights:  199
## initial  value 129.078278
## iter  10 value 26.091435
## iter  20 value 20.926452
## iter  30 value 20.128154
## iter  40 value 19.756348
## iter  50 value 19.567738
## iter  60 value 19.393014
## iter  70 value 19.254464
## iter  80 value 19.129402
## iter  90 value 19.111269
## iter 100 value 19.092507
## final  value 19.092507
## stopped after 100 iterations
## # weights:  217
## initial  value 135.178003
## iter  10 value 25.203920
## iter  20 value 19.726073
## iter  30 value 19.360309
## iter  40 value 19.299037
## iter  50 value 19.158139
## iter  60 value 19.039151
## iter  70 value 19.021037
## iter  80 value 19.015135
## iter  90 value 19.010591
## iter 100 value 19.010309
## final  value 19.010309
## stopped after 100 iterations
## # weights:  235
## initial  value 141.723784
## iter  10 value 26.474305
## iter  20 value 20.650985
## iter  30 value 19.789092
```

```
## iter  40 value 19.261737
## iter  50 value 19.206324
## iter  60 value 19.166342
## iter  70 value 19.146008
## iter  80 value 19.141114
## iter  90 value 19.140026
## iter 100 value 19.120682
## final  value 19.120682
## stopped after 100 iterations
## # weights:  253
## initial  value 128.451010
## iter  10 value 24.281316
## iter  20 value 20.408963
## iter  30 value 19.593248
## iter  40 value 19.262521
## iter  50 value 19.073632
## iter  60 value 19.019262
## iter  70 value 19.004473
## iter  80 value 18.999302
## iter  90 value 18.998530
## iter 100 value 18.998432
## final  value 18.998432
## stopped after 100 iterations
## # weights:  271
## initial  value 139.503604
## iter  10 value 24.171117
## iter  20 value 20.020552
## iter  30 value 19.348822
## iter  40 value 19.107130
## iter  50 value 19.049236
## iter  60 value 19.019109
## iter  70 value 19.006478
## iter  80 value 19.003684
## iter  90 value 19.000466
## iter 100 value 18.998086
## final  value 18.998086
## stopped after 100 iterations
## # weights:  289
## initial  value 140.564762
## iter  10 value 31.092784
## iter  20 value 21.160493
## iter  30 value 19.635248
## iter  40 value 19.355225
## iter  50 value 19.271816
## iter  60 value 19.168364
## iter  70 value 19.026059
## iter  80 value 19.010352
## iter  90 value 19.003871
## iter 100 value 19.002758
## final  value 19.002758
## stopped after 100 iterations
## # weights:  307
## initial  value 113.392016
## iter  10 value 23.322092
```

```
## iter  20 value 19.917816
## iter  30 value 19.380815
## iter  40 value 19.258116
## iter  50 value 19.217271
## iter  60 value 19.194411
## iter  70 value 19.187243
## iter  80 value 19.185859
## iter  90 value 19.185556
## iter 100 value 19.185489
## final  value 19.185489
## stopped after 100 iterations
## # weights:  325
## initial  value 149.753168
## iter  10 value 25.831506
## iter  20 value 20.097840
## iter  30 value 19.186940
## iter  40 value 19.039849
## iter  50 value 19.011072
## iter  60 value 18.996376
## iter  70 value 18.993080
## iter  80 value 18.991237
## iter  90 value 18.990028
## iter 100 value 18.989446
## final  value 18.989446
## stopped after 100 iterations
## # weights:  19
## initial  value 125.597509
## iter  10 value 50.014047
## iter  20 value 15.832099
## iter  30 value 15.025093
## iter  40 value 11.894542
## iter  50 value 11.198495
## iter  60 value 11.101472
## iter  70 value 8.101448
## iter  80 value 5.843069
## iter  90 value 5.635058
## iter 100 value 5.551947
## final  value 5.551947
## stopped after 100 iterations
## # weights:  37
## initial  value 122.083471
## iter  10 value 30.190531
## iter  20 value 8.987175
## iter  30 value 5.438217
## iter  40 value 5.424934
## iter  50 value 5.424886
## iter  60 value 5.424841
## iter  60 value 5.424841
## iter  60 value 5.424841
## final  value 5.424841
## converged
## # weights:  55
## initial  value 137.822847
## iter  10 value 24.382556
```

```
## iter  20 value 7.937055
## iter  30 value 2.599440
## iter  40 value 2.508836
## iter  50 value 2.503417
## iter  60 value 2.502359
## iter  70 value 2.502123
## iter  80 value 2.502082
## iter  90 value 2.502057
## iter 100 value 2.502040
## final  value 2.502040
## stopped after 100 iterations
## # weights:  73
## initial  value 114.764750
## iter  10 value 19.795089
## iter  20 value 4.454947
## iter  30 value 0.225210
## iter  40 value 0.000991
## final  value 0.000067
## converged
## # weights:  91
## initial  value 122.120482
## iter  10 value 21.580576
## iter  20 value 6.938426
## iter  30 value 3.053495
## iter  40 value 2.370011
## iter  50 value 1.998042
## iter  60 value 1.952224
## iter  70 value 1.933856
## iter  80 value 1.920465
## iter  90 value 1.915848
## iter 100 value 1.912978
## final  value 1.912978
## stopped after 100 iterations
## # weights:  109
## initial  value 116.597825
## iter  10 value 8.454836
## iter  20 value 0.310316
## iter  30 value 0.011388
## iter  40 value 0.000352
## final  value 0.000089
## converged
## # weights:  127
## initial  value 139.036175
## iter  10 value 13.220100
## iter  20 value 0.353936
## iter  30 value 0.018821
## iter  40 value 0.004013
## final  value 0.000078
## converged
## # weights:  145
## initial  value 116.803550
## iter  10 value 17.490529
## iter  20 value 0.418031
## iter  30 value 0.010110
```

```
## iter  40 value 0.001258
## iter  50 value 0.000368
## iter  60 value 0.000206
## final  value 0.000081
## converged
## # weights:  163
## initial  value 144.080753
## iter  10 value 14.293133
## iter  20 value 0.206239
## iter  30 value 0.004531
## final  value 0.000096
## converged
## # weights:  181
## initial  value 131.007992
## iter  10 value 9.799666
## iter  20 value 0.203133
## iter  30 value 0.009108
## iter  40 value 0.001123
## final  value 0.000092
## converged
## # weights:  199
## initial  value 150.426968
## iter  10 value 18.814542
## iter  20 value 1.749830
## iter  30 value 0.047639
## iter  40 value 0.001448
## iter  50 value 0.000202
## final  value 0.000089
## converged
## # weights:  217
## initial  value 128.845401
## iter  10 value 13.139288
## iter  20 value 0.223014
## iter  30 value 0.003539
## final  value 0.000096
## converged
## # weights:  235
## initial  value 138.411355
## iter  10 value 8.136835
## iter  20 value 0.110224
## iter  30 value 0.002518
## iter  40 value 0.000426
## iter  50 value 0.000138
## final  value 0.000100
## converged
## # weights:  253
## initial  value 106.924946
## iter  10 value 8.457821
## iter  20 value 0.319769
## iter  30 value 0.007899
## iter  40 value 0.000735
## iter  50 value 0.000264
## final  value 0.000088
## converged
```

```
## # weights:  271
## initial  value 139.561126
## iter  10 value 16.212926
## iter  20 value 1.194792
## iter  30 value 0.035629
## iter  40 value 0.005198
## iter  50 value 0.001147
## iter  60 value 0.000228
## final  value 0.000091
## converged
## # weights:  289
## initial  value 126.703127
## iter  10 value 10.410883
## iter  20 value 0.173628
## iter  30 value 0.004884
## iter  40 value 0.000670
## final  value 0.000092
## converged
## # weights:  307
## initial  value 141.047153
## iter  10 value 10.905982
## iter  20 value 0.306876
## iter  30 value 0.003815
## iter  40 value 0.000350
## iter  50 value 0.000140
## iter  50 value 0.000093
## iter  50 value 0.000092
## final  value 0.000092
## converged
## # weights:  325
## initial  value 163.109600
## iter  10 value 9.910713
## iter  20 value 0.066595
## iter  30 value 0.001114
## final  value 0.000081
## converged
## # weights:  19
## initial  value 116.783757
## iter  10 value 48.275227
## iter  20 value 29.895892
## iter  30 value 22.940782
## iter  40 value 20.592026
## iter  50 value 20.587912
## final  value 20.587512
## converged
## # weights:  37
## initial  value 121.192942
## iter  10 value 37.570734
## iter  20 value 25.182618
## iter  30 value 16.627616
## iter  40 value 14.778894
## iter  50 value 14.735912
## iter  60 value 14.725360
## final  value 14.725186
```

```
## converged
## # weights:  55
## initial  value 114.291099
## iter  10 value 40.158755
## iter  20 value 16.523472
## iter  30 value 14.225272
## iter  40 value 14.182653
## iter  50 value 14.180679
## final  value 14.180655
## converged
## # weights:  73
## initial  value 118.178603
## iter  10 value 36.931756
## iter  20 value 17.480508
## iter  30 value 14.777678
## iter  40 value 13.319646
## iter  50 value 13.103939
## iter  60 value 13.048159
## iter  70 value 13.043685
## iter  80 value 13.043127
## iter  90 value 13.043008
## final  value 13.043007
## converged
## # weights:  91
## initial  value 108.145279
## iter  10 value 18.232103
## iter  20 value 13.999986
## iter  30 value 13.495988
## iter  40 value 13.395559
## iter  50 value 13.252950
## iter  60 value 13.078180
## iter  70 value 12.759748
## iter  80 value 12.749935
## iter  90 value 12.712377
## iter 100 value 12.610057
## final  value 12.610057
## stopped after 100 iterations
## # weights:  109
## initial  value 130.289131
## iter  10 value 29.395382
## iter  20 value 17.065939
## iter  30 value 13.867035
## iter  40 value 12.841267
## iter  50 value 12.682703
## iter  60 value 12.651975
## iter  70 value 12.644446
## iter  80 value 12.641006
## iter  90 value 12.639725
## iter 100 value 12.638884
## final  value 12.638884
## stopped after 100 iterations
## # weights:  127
## initial  value 124.719096
## iter  10 value 19.133482
```

```
## iter  20 value 13.957508
## iter  30 value 12.519307
## iter  40 value 12.175564
## iter  50 value 12.060733
## iter  60 value 11.849548
## iter  70 value 11.775616
## iter  80 value 11.769726
## iter  90 value 11.768387
## iter 100 value 11.767793
## final  value 11.767793
## stopped after 100 iterations
## # weights:  145
## initial  value 127.490828
## iter  10 value 29.685947
## iter  20 value 14.497921
## iter  30 value 12.350172
## iter  40 value 11.931092
## iter  50 value 11.789119
## iter  60 value 11.725620
## iter  70 value 11.675041
## iter  80 value 11.654513
## iter  90 value 11.648822
## iter 100 value 11.644368
## final  value 11.644368
## stopped after 100 iterations
## # weights:  163
## initial  value 133.678198
## iter  10 value 26.534866
## iter  20 value 13.837963
## iter  30 value 11.993170
## iter  40 value 11.875745
## iter  50 value 11.857124
## iter  60 value 11.847046
## iter  70 value 11.812030
## iter  80 value 11.802021
## iter  90 value 11.786794
## iter 100 value 11.740322
## final  value 11.740322
## stopped after 100 iterations
## # weights:  181
## initial  value 116.083779
## iter  10 value 16.042920
## iter  20 value 12.402748
## iter  30 value 12.067529
## iter  40 value 11.950821
## iter  50 value 11.904821
## iter  60 value 11.878588
## iter  70 value 11.841630
## iter  80 value 11.831921
## iter  90 value 11.825590
## iter 100 value 11.803753
## final  value 11.803753
## stopped after 100 iterations
## # weights:  199
```

```
## initial  value 130.207736
## iter  10 value 17.958515
## iter  20 value 12.696994
## iter  30 value 11.712229
## iter  40 value 11.545502
## iter  50 value 11.516146
## iter  60 value 11.462242
## iter  70 value 11.425003
## iter  80 value 11.418551
## iter  90 value 11.415630
## iter 100 value 11.413006
## final  value 11.413006
## stopped after 100 iterations
## # weights:  217
## initial  value 118.578852
## iter  10 value 20.330081
## iter  20 value 13.180873
## iter  30 value 11.843660
## iter  40 value 11.620118
## iter  50 value 11.568402
## iter  60 value 11.550432
## iter  70 value 11.545362
## iter  80 value 11.542194
## iter  90 value 11.541232
## iter 100 value 11.530556
## final  value 11.530556
## stopped after 100 iterations
## # weights:  235
## initial  value 126.712532
## iter  10 value 29.792577
## iter  20 value 14.453098
## iter  30 value 12.383138
## iter  40 value 11.888027
## iter  50 value 11.616682
## iter  60 value 11.555445
## iter  70 value 11.531348
## iter  80 value 11.520456
## iter  90 value 11.514928
## iter 100 value 11.514178
## final  value 11.514178
## stopped after 100 iterations
## # weights:  253
## initial  value 144.756057
## iter  10 value 19.017093
## iter  20 value 13.223154
## iter  30 value 11.873194
## iter  40 value 11.605821
## iter  50 value 11.543905
## iter  60 value 11.521259
## iter  70 value 11.504400
## iter  80 value 11.496455
## iter  90 value 11.494860
## iter 100 value 11.494264
## final  value 11.494264
```

```
## stopped after 100 iterations
## # weights:  271
## initial  value 176.163672
## iter  10 value 20.905562
## iter  20 value 14.115604
## iter  30 value 12.393871
## iter  40 value 11.852781
## iter  50 value 11.675717
## iter  60 value 11.603220
## iter  70 value 11.571965
## iter  80 value 11.543374
## iter  90 value 11.478742
## iter 100 value 11.454023
## final  value 11.454023
## stopped after 100 iterations
## # weights:  289
## initial  value 119.192750
## iter  10 value 17.829078
## iter  20 value 12.599855
## iter  30 value 11.839350
## iter  40 value 11.589963
## iter  50 value 11.538439
## iter  60 value 11.498952
## iter  70 value 11.439602
## iter  80 value 11.392112
## iter  90 value 11.385546
## iter 100 value 11.382294
## final  value 11.382294
## stopped after 100 iterations
## # weights:  307
## initial  value 157.530459
## iter  10 value 19.154192
## iter  20 value 12.975041
## iter  30 value 12.064231
## iter  40 value 11.706791
## iter  50 value 11.523148
## iter  60 value 11.450260
## iter  70 value 11.417774
## iter  80 value 11.389772
## iter  90 value 11.381323
## iter 100 value 11.378296
## final  value 11.378296
## stopped after 100 iterations
## # weights:  325
## initial  value 132.106751
## iter  10 value 24.909792
## iter  20 value 15.106184
## iter  30 value 12.157093
## iter  40 value 11.674625
## iter  50 value 11.565774
## iter  60 value 11.478959
## iter  70 value 11.430447
## iter  80 value 11.407827
## iter  90 value 11.395208
```

```
## iter 100 value 11.390356
## final  value 11.390356
## stopped after 100 iterations
## # weights:  19
## initial  value 114.012915
## iter  10 value 46.891112
## iter  20 value 33.289077
## iter  30 value 28.987820
## iter  40 value 27.517459
## iter  50 value 27.481185
## final  value 27.480083
## converged
## # weights:  37
## initial  value 135.624878
## iter  10 value 50.650414
## iter  20 value 29.252311
## iter  30 value 26.035739
## iter  40 value 23.414283
## iter  50 value 22.947268
## iter  60 value 22.938637
## iter  60 value 22.938636
## iter  60 value 22.938636
## final  value 22.938636
## converged
## # weights:  55
## initial  value 132.810685
## iter  10 value 43.951987
## iter  20 value 27.024774
## iter  30 value 24.266494
## iter  40 value 21.769430
## iter  50 value 20.465754
## iter  60 value 20.327445
## iter  70 value 20.305340
## iter  80 value 20.302704
## iter  90 value 20.302615
## final  value 20.302612
## converged
## # weights:  73
## initial  value 137.867508
## iter  10 value 32.704337
## iter  20 value 21.242289
## iter  30 value 20.011034
## iter  40 value 19.741203
## iter  50 value 19.717978
## iter  60 value 19.717593
## final  value 19.717586
## converged
## # weights:  91
## initial  value 119.832594
## iter  10 value 24.050316
## iter  20 value 19.597917
## iter  30 value 19.392258
## iter  40 value 19.382850
## iter  50 value 19.382606
```

```
## final  value 19.382590
## converged
## # weights:  109
## initial  value 135.165315
## iter  10 value 42.599971
## iter  20 value 20.616850
## iter  30 value 19.270188
## iter  40 value 18.633414
## iter  50 value 18.314944
## iter  60 value 18.290973
## iter  70 value 18.284323
## iter  80 value 18.284109
## final  value 18.284105
## converged
## # weights:  127
## initial  value 120.550194
## iter  10 value 23.189334
## iter  20 value 19.993088
## iter  30 value 19.157664
## iter  40 value 18.897257
## iter  50 value 18.429926
## iter  60 value 18.395850
## iter  70 value 18.339663
## iter  80 value 18.271942
## iter  90 value 18.243957
## iter 100 value 18.243417
## final  value 18.243417
## stopped after 100 iterations
## # weights:  145
## initial  value 113.382398
## iter  10 value 27.785035
## iter  20 value 20.250468
## iter  30 value 18.644017
## iter  40 value 18.423995
## iter  50 value 18.306641
## iter  60 value 18.232734
## iter  70 value 18.225033
## iter  80 value 18.224915
## iter  90 value 18.223995
## iter 100 value 18.216345
## final  value 18.216345
## stopped after 100 iterations
## # weights:  163
## initial  value 135.114082
## iter  10 value 27.863450
## iter  20 value 20.191204
## iter  30 value 18.520302
## iter  40 value 18.234055
## iter  50 value 18.128385
## iter  60 value 18.082264
## iter  70 value 18.074600
## iter  80 value 18.072444
## iter  90 value 18.072276
## iter 100 value 18.072264
```

```
## final  value 18.072264
## stopped after 100 iterations
## # weights:  181
## initial  value 127.622526
## iter  10 value 22.213985
## iter  20 value 19.117121
## iter  30 value 18.525024
## iter  40 value 18.265901
## iter  50 value 18.174088
## iter  60 value 18.155912
## iter  70 value 18.100335
## iter  80 value 18.088462
## iter  90 value 18.087593
## iter 100 value 18.087260
## final  value 18.087260
## stopped after 100 iterations
## # weights:  199
## initial  value 142.952395
## iter  10 value 26.701907
## iter  20 value 19.316327
## iter  30 value 18.317553
## iter  40 value 18.100136
## iter  50 value 17.988977
## iter  60 value 17.959396
## iter  70 value 17.956889
## iter  80 value 17.950892
## iter  90 value 17.949572
## iter 100 value 17.949261
## final  value 17.949261
## stopped after 100 iterations
## # weights:  217
## initial  value 125.572889
## iter  10 value 29.006833
## iter  20 value 20.067904
## iter  30 value 18.303748
## iter  40 value 18.082166
## iter  50 value 17.998351
## iter  60 value 17.968986
## iter  70 value 17.963891
## iter  80 value 17.947705
## iter  90 value 17.941133
## iter 100 value 17.940838
## final  value 17.940838
## stopped after 100 iterations
## # weights:  235
## initial  value 128.657966
## iter  10 value 44.044713
## iter  20 value 20.980046
## iter  30 value 18.667978
## iter  40 value 18.223850
## iter  50 value 18.094591
## iter  60 value 18.057061
## iter  70 value 18.050277
## iter  80 value 18.040551
```

```
## iter  90 value 18.038346
## iter 100 value 18.037755
## final  value 18.037755
## stopped after 100 iterations
## # weights:  253
## initial  value 155.170556
## iter  10 value 34.702633
## iter  20 value 21.275099
## iter  30 value 18.761899
## iter  40 value 18.222714
## iter  50 value 18.054768
## iter  60 value 18.028321
## iter  70 value 18.020338
## iter  80 value 18.016974
## iter  90 value 18.014440
## iter 100 value 18.013380
## final  value 18.013380
## stopped after 100 iterations
## # weights:  271
## initial  value 113.514658
## iter  10 value 24.163519
## iter  20 value 18.924358
## iter  30 value 18.402909
## iter  40 value 18.226593
## iter  50 value 18.160785
## iter  60 value 18.128827
## iter  70 value 18.106592
## iter  80 value 18.103027
## iter  90 value 18.084793
## iter 100 value 18.061066
## final  value 18.061066
## stopped after 100 iterations
## # weights:  289
## initial  value 199.391849
## iter  10 value 26.862740
## iter  20 value 19.979251
## iter  30 value 18.449561
## iter  40 value 18.110214
## iter  50 value 18.033671
## iter  60 value 18.012603
## iter  70 value 17.996197
## iter  80 value 17.986541
## iter  90 value 17.985148
## iter 100 value 17.984384
## final  value 17.984384
## stopped after 100 iterations
## # weights:  307
## initial  value 229.842809
## iter  10 value 32.571032
## iter  20 value 20.108813
## iter  30 value 18.701612
## iter  40 value 18.251303
## iter  50 value 18.181109
## iter  60 value 18.113056
```

```
## iter  70 value 18.072354
## iter  80 value 18.051511
## iter  90 value 18.037235
## iter 100 value 18.018023
## final  value 18.018023
## stopped after 100 iterations
## # weights:  325
## initial  value 145.359700
## iter  10 value 31.984934
## iter  20 value 19.639889
## iter  30 value 18.354940
## iter  40 value 18.106958
## iter  50 value 18.013627
## iter  60 value 18.003564
## iter  70 value 18.001336
## iter  80 value 17.999701
## iter  90 value 17.998544
## iter 100 value 17.998098
## final  value 17.998098
## stopped after 100 iterations
## # weights:  19
## initial  value 125.086013
## iter  10 value 34.499726
## iter  20 value 22.966862
## iter  30 value 21.501159
## iter  40 value 19.784984
## iter  50 value 18.746898
## iter  60 value 16.708289
## iter  70 value 16.213690
## iter  80 value 16.112030
## iter  90 value 15.630435
## iter 100 value 15.420410
## final  value 15.420410
## stopped after 100 iterations
## # weights:  37
## initial  value 120.042648
## iter  10 value 23.231758
## iter  20 value 9.430092
## iter  30 value 8.131552
## iter  40 value 6.296853
## iter  50 value 5.452711
## iter  60 value 5.438854
## iter  70 value 5.437550
## iter  80 value 5.436817
## iter  90 value 5.436800
## final  value 5.436770
## converged
## # weights:  55
## initial  value 114.851789
## iter  10 value 12.807167
## iter  20 value 4.463319
## iter  30 value 2.663180
## iter  40 value 2.252173
## iter  50 value 2.249409
```

```
## final  value 2.249341
## converged
## # weights:  73
## initial  value 120.343065
## iter  10 value 15.222973
## iter  20 value 3.047175
## iter  30 value 0.027445
## iter  40 value 0.000197
## final  value 0.000063
## converged
## # weights:  91
## initial  value 116.779546
## iter  10 value 12.796732
## iter  20 value 2.758676
## iter  30 value 1.940305
## iter  40 value 0.070308
## iter  50 value 0.028630
## iter  60 value 0.016714
## iter  70 value 0.007853
## iter  80 value 0.005156
## iter  90 value 0.001149
## iter 100 value 0.000705
## final  value 0.000705
## stopped after 100 iterations
## # weights:  109
## initial  value 117.292395
## iter  10 value 16.945330
## iter  20 value 1.828998
## iter  30 value 0.292618
## iter  40 value 0.000859
## final  value 0.000087
## converged
## # weights:  127
## initial  value 128.430124
## iter  10 value 16.470712
## iter  20 value 2.063112
## iter  30 value 0.021116
## iter  40 value 0.000299
## final  value 0.000090
## converged
## # weights:  145
## initial  value 130.403775
## iter  10 value 15.158373
## iter  20 value 1.483854
## iter  30 value 0.010292
## iter  40 value 0.000205
## final  value 0.000062
## converged
## # weights:  163
## initial  value 116.842302
## iter  10 value 26.701173
## iter  20 value 7.057086
## iter  30 value 1.671564
## iter  40 value 1.394235
```

```
## iter  50 value 1.387741
## iter  60 value 1.387339
## iter  70 value 1.386367
## final  value 1.386294
## converged
## # weights:  181
## initial  value 133.745149
## iter  10 value 14.619751
## iter  20 value 0.429966
## iter  30 value 0.004994
## iter  40 value 0.000159
## final  value 0.000084
## converged
## # weights:  199
## initial  value 126.115374
## iter  10 value 19.247225
## iter  20 value 3.647777
## iter  30 value 0.039346
## iter  40 value 0.002187
## final  value 0.000066
## converged
## # weights:  217
## initial  value 142.276171
## iter  10 value 12.738243
## iter  20 value 2.172374
## iter  30 value 0.037681
## iter  40 value 0.002325
## iter  50 value 0.000264
## final  value 0.000087
## converged
## # weights:  235
## initial  value 183.600711
## iter  10 value 9.678278
## iter  20 value 0.715698
## iter  30 value 0.002459
## final  value 0.000076
## converged
## # weights:  253
## initial  value 122.324588
## iter  10 value 15.757066
## iter  20 value 2.249735
## iter  30 value 0.030766
## iter  40 value 0.003508
## iter  50 value 0.000212
## final  value 0.000090
## converged
## # weights:  271
## initial  value 131.152795
## iter  10 value 11.145014
## iter  20 value 0.469349
## iter  30 value 0.002931
## iter  40 value 0.000260
## final  value 0.000098
## converged
```

```
## # weights:  289
## initial  value 104.523959
## iter  10 value 9.725202
## iter  20 value 0.126397
## iter  30 value 0.003422
## final  value 0.000065
## converged
## # weights:  307
## initial  value 174.323413
## iter  10 value 9.752819
## iter  20 value 0.365559
## iter  30 value 0.008379
## iter  40 value 0.000958
## final  value 0.000090
## converged
## # weights:  325
## initial  value 172.861252
## iter  10 value 10.577858
## iter  20 value 0.624930
## iter  30 value 0.008895
## iter  40 value 0.000886
## iter  50 value 0.000121
## final  value 0.000098
## converged
## # weights:  19
## initial  value 119.911986
## iter  10 value 36.296760
## iter  20 value 26.866515
## iter  30 value 25.108426
## iter  40 value 25.103663
## iter  40 value 25.103662
## final  value 25.103662
## converged
## # weights:  37
## initial  value 124.987643
## iter  10 value 22.519168
## iter  20 value 17.638961
## iter  30 value 17.221707
## iter  40 value 16.999707
## iter  50 value 16.987950
## final  value 16.987941
## converged
## # weights:  55
## initial  value 113.294761
## iter  10 value 24.376998
## iter  20 value 18.024449
## iter  30 value 17.024411
## iter  40 value 16.501676
## iter  50 value 16.381049
## iter  60 value 16.327134
## iter  70 value 16.324750
## final  value 16.324748
## converged
## # weights:  73
```

```
## initial  value 129.150365
## iter  10 value 47.189282
## iter  20 value 22.665042
## iter  30 value 19.075062
## iter  40 value 17.257357
## iter  50 value 16.152640
## iter  60 value 15.968461
## iter  70 value 15.753035
## iter  80 value 15.595693
## iter  90 value 15.559153
## iter 100 value 15.399320
## final  value 15.399320
## stopped after 100 iterations
## # weights:  91
## initial  value 120.639665
## iter  10 value 24.427806
## iter  20 value 16.171400
## iter  30 value 14.498128
## iter  40 value 14.001781
## iter  50 value 13.406627
## iter  60 value 13.335082
## iter  70 value 13.334007
## iter  80 value 13.333695
## final  value 13.333689
## converged
## # weights:  109
## initial  value 116.341803
## iter  10 value 24.242592
## iter  20 value 16.354015
## iter  30 value 15.366106
## iter  40 value 15.084921
## iter  50 value 13.948359
## iter  60 value 13.659884
## iter  70 value 13.547882
## iter  80 value 13.466111
## iter  90 value 13.454118
## iter 100 value 13.446559
## final  value 13.446559
## stopped after 100 iterations
## # weights:  127
## initial  value 121.298838
## iter  10 value 21.668805
## iter  20 value 16.034730
## iter  30 value 14.637742
## iter  40 value 14.159675
## iter  50 value 14.028652
## iter  60 value 13.958423
## iter  70 value 13.640302
## iter  80 value 13.390232
## iter  90 value 13.376746
## iter 100 value 13.375619
## final  value 13.375619
## stopped after 100 iterations
## # weights:  145
```

```
## initial  value 132.217703
## iter  10 value 18.695306
## iter  20 value 15.088022
## iter  30 value 13.544281
## iter  40 value 13.218098
## iter  50 value 13.124935
## iter  60 value 13.064264
## iter  70 value 13.052253
## iter  80 value 13.050139
## iter  90 value 13.049069
## iter 100 value 13.048969
## final  value 13.048969
## stopped after 100 iterations
## # weights:  163
## initial  value 127.081652
## iter  10 value 21.974885
## iter  20 value 15.892004
## iter  30 value 13.710824
## iter  40 value 13.260513
## iter  50 value 13.158138
## iter  60 value 13.140719
## iter  70 value 13.129804
## iter  80 value 13.126566
## iter  90 value 13.122037
## iter 100 value 13.117670
## final  value 13.117670
## stopped after 100 iterations
## # weights:  181
## initial  value 119.304118
## iter  10 value 22.297413
## iter  20 value 15.302295
## iter  30 value 13.898026
## iter  40 value 13.372640
## iter  50 value 13.169183
## iter  60 value 13.083725
## iter  70 value 13.051206
## iter  80 value 13.023892
## iter  90 value 12.975278
## iter 100 value 12.958658
## final  value 12.958658
## stopped after 100 iterations
## # weights:  199
## initial  value 111.753998
## iter  10 value 19.781831
## iter  20 value 14.005348
## iter  30 value 13.107636
## iter  40 value 12.981135
## iter  50 value 12.961942
## iter  60 value 12.958462
## iter  70 value 12.957782
## iter  80 value 12.957157
## iter  90 value 12.956953
## iter 100 value 12.956922
## final  value 12.956922
```

```
## stopped after 100 iterations
## # weights:  217
## initial  value 130.575960
## iter  10 value 27.306723
## iter  20 value 16.927130
## iter  30 value 14.471609
## iter  40 value 13.663625
## iter  50 value 13.257721
## iter  60 value 13.117077
## iter  70 value 13.003272
## iter  80 value 12.960113
## iter  90 value 12.952266
## iter 100 value 12.928642
## final  value 12.928642
## stopped after 100 iterations
## # weights:  235
## initial  value 113.347648
## iter  10 value 19.202566
## iter  20 value 14.473996
## iter  30 value 13.536398
## iter  40 value 13.221109
## iter  50 value 13.121327
## iter  60 value 13.069499
## iter  70 value 13.006955
## iter  80 value 12.980127
## iter  90 value 12.968734
## iter 100 value 12.962720
## final  value 12.962720
## stopped after 100 iterations
## # weights:  253
## initial  value 110.018892
## iter  10 value 19.561862
## iter  20 value 14.790433
## iter  30 value 13.748455
## iter  40 value 13.227826
## iter  50 value 13.063120
## iter  60 value 13.000604
## iter  70 value 12.968256
## iter  80 value 12.921868
## iter  90 value 12.907801
## iter 100 value 12.904651
## final  value 12.904651
## stopped after 100 iterations
## # weights:  271
## initial  value 154.111155
## iter  10 value 23.075500
## iter  20 value 15.189322
## iter  30 value 14.007661
## iter  40 value 13.587405
## iter  50 value 13.148226
## iter  60 value 12.977861
## iter  70 value 12.930342
## iter  80 value 12.916446
## iter  90 value 12.912913
```

```
## iter 100 value 12.911168
## final  value 12.911168
## stopped after 100 iterations
## # weights:  289
## initial  value 123.117204
## iter  10 value 25.653702
## iter  20 value 16.467302
## iter  30 value 14.009713
## iter  40 value 13.659610
## iter  50 value 13.444815
## iter  60 value 13.089254
## iter  70 value 13.004956
## iter  80 value 12.932263
## iter  90 value 12.918934
## iter 100 value 12.914404
## final  value 12.914404
## stopped after 100 iterations
## # weights:  307
## initial  value 121.307184
## iter  10 value 39.396403
## iter  20 value 16.726039
## iter  30 value 14.132898
## iter  40 value 13.320127
## iter  50 value 13.045199
## iter  60 value 12.977429
## iter  70 value 12.936443
## iter  80 value 12.929534
## iter  90 value 12.928269
## iter 100 value 12.927750
## final  value 12.927750
## stopped after 100 iterations
## # weights:  325
## initial  value 138.763467
## iter  10 value 19.603835
## iter  20 value 14.398218
## iter  30 value 13.316073
## iter  40 value 12.948281
## iter  50 value 12.873338
## iter  60 value 12.853211
## iter  70 value 12.843843
## iter  80 value 12.823460
## iter  90 value 12.821527
## iter 100 value 12.819930
## final  value 12.819930
## stopped after 100 iterations
## # weights:  19
## initial  value 132.265954
## iter  10 value 53.803214
## iter  20 value 31.587004
## iter  30 value 29.931155
## iter  40 value 29.835417
## iter  50 value 29.835308
## final  value 29.835303
## converged
```

```
## # weights:  37
## initial  value 142.115493
## iter  10 value 40.841723
## iter  20 value 25.257054
## iter  30 value 23.187546
## iter  40 value 22.475052
## iter  50 value 22.439183
## final  value 22.439134
## converged
## # weights:  55
## initial  value 120.726326
## iter  10 value 46.567813
## iter  20 value 27.898279
## iter  30 value 25.518434
## iter  40 value 24.674120
## iter  50 value 24.313238
## iter  60 value 24.222569
## iter  70 value 24.222404
## iter  70 value 24.222404
## iter  70 value 24.222404
## final  value 24.222404
## converged
## # weights:  73
## initial  value 111.134996
## iter  10 value 28.030713
## iter  20 value 22.969307
## iter  30 value 22.156557
## iter  40 value 22.097195
## iter  50 value 22.094796
## final  value 22.094743
## converged
## # weights:  91
## initial  value 144.673312
## iter  10 value 24.941292
## iter  20 value 21.494059
## iter  30 value 20.684789
## iter  40 value 20.588198
## iter  50 value 20.584570
## final  value 20.584278
## converged
## # weights:  109
## initial  value 114.033058
## iter  10 value 27.737495
## iter  20 value 22.683814
## iter  30 value 21.552162
## iter  40 value 21.046595
## iter  50 value 20.843002
## iter  60 value 20.557511
## iter  70 value 20.460335
## iter  80 value 20.422136
## iter  90 value 20.419839
## iter 100 value 20.419728
## final  value 20.419728
## stopped after 100 iterations
```

```
## # weights:  127
## initial  value 118.102528
## iter  10 value 30.719891
## iter  20 value 21.974570
## iter  30 value 20.868761
## iter  40 value 20.430852
## iter  50 value 20.116625
## iter  60 value 19.912460
## iter  70 value 19.888719
## iter  80 value 19.782474
## iter  90 value 19.779133
## iter 100 value 19.778166
## final  value 19.778166
## stopped after 100 iterations
## # weights:  145
## initial  value 119.432954
## iter  10 value 24.864667
## iter  20 value 20.461301
## iter  30 value 20.065688
## iter  40 value 19.754618
## iter  50 value 19.652638
## iter  60 value 19.650554
## iter  70 value 19.650159
## iter  80 value 19.650052
## final  value 19.650049
## converged
## # weights:  163
## initial  value 123.414861
## iter  10 value 26.847797
## iter  20 value 21.237218
## iter  30 value 20.513606
## iter  40 value 20.313501
## iter  50 value 20.117480
## iter  60 value 19.964354
## iter  70 value 19.695869
## iter  80 value 19.632563
## iter  90 value 19.596216
## iter 100 value 19.588872
## final  value 19.588872
## stopped after 100 iterations
## # weights:  181
## initial  value 133.242077
## iter  10 value 25.106216
## iter  20 value 21.027732
## iter  30 value 20.309786
## iter  40 value 20.051967
## iter  50 value 19.717786
## iter  60 value 19.608157
## iter  70 value 19.576023
## iter  80 value 19.567085
## iter  90 value 19.561184
## iter 100 value 19.559817
## final  value 19.559817
## stopped after 100 iterations
```

```
## # weights:  199
## initial  value 129.529458
## iter  10 value 26.268025
## iter  20 value 20.984032
## iter  30 value 20.313745
## iter  40 value 20.119955
## iter  50 value 19.836141
## iter  60 value 19.730729
## iter  70 value 19.591208
## iter  80 value 19.545944
## iter  90 value 19.540897
## iter 100 value 19.540608
## final  value 19.540608
## stopped after 100 iterations
## # weights:  217
## initial  value 114.721074
## iter  10 value 29.822400
## iter  20 value 21.267044
## iter  30 value 19.972186
## iter  40 value 19.675334
## iter  50 value 19.599713
## iter  60 value 19.572647
## iter  70 value 19.561905
## iter  80 value 19.559413
## iter  90 value 19.558710
## iter 100 value 19.558316
## final  value 19.558316
## stopped after 100 iterations
## # weights:  235
## initial  value 141.984472
## iter  10 value 36.135008
## iter  20 value 21.203769
## iter  30 value 20.334196
## iter  40 value 20.173561
## iter  50 value 20.138535
## iter  60 value 20.116196
## iter  70 value 20.111032
## iter  80 value 20.109442
## iter  90 value 20.109035
## iter 100 value 20.109018
## final  value 20.109018
## stopped after 100 iterations
## # weights:  253
## initial  value 131.553811
## iter  10 value 23.823861
## iter  20 value 21.153240
## iter  30 value 20.505677
## iter  40 value 20.268852
## iter  50 value 20.189160
## iter  60 value 19.935772
## iter  70 value 19.691306
## iter  80 value 19.633796
## iter  90 value 19.610779
## iter 100 value 19.586464
```

```
## final  value 19.586464
## stopped after 100 iterations
## # weights:  271
## initial  value 128.008354
## iter  10 value 23.864014
## iter  20 value 20.655332
## iter  30 value 20.178589
## iter  40 value 19.988022
## iter  50 value 19.548887
## iter  60 value 19.510670
## iter  70 value 19.501514
## iter  80 value 19.499812
## iter  90 value 19.499269
## iter 100 value 19.497781
## final  value 19.497781
## stopped after 100 iterations
## # weights:  289
## initial  value 111.009261
## iter  10 value 31.476372
## iter  20 value 21.116724
## iter  30 value 20.028687
## iter  40 value 19.581865
## iter  50 value 19.526382
## iter  60 value 19.495902
## iter  70 value 19.486037
## iter  80 value 19.481821
## iter  90 value 19.481341
## iter 100 value 19.481252
## final  value 19.481252
## stopped after 100 iterations
## # weights:  307
## initial  value 117.446081
## iter  10 value 36.997072
## iter  20 value 22.151761
## iter  30 value 20.427335
## iter  40 value 19.876134
## iter  50 value 19.535713
## iter  60 value 19.491718
## iter  70 value 19.479718
## iter  80 value 19.475439
## iter  90 value 19.474373
## iter 100 value 19.474138
## final  value 19.474138
## stopped after 100 iterations
## # weights:  325
## initial  value 140.693781
## iter  10 value 24.989350
## iter  20 value 20.880147
## iter  30 value 20.191803
## iter  40 value 19.921127
## iter  50 value 19.568936
## iter  60 value 19.494967
## iter  70 value 19.471681
## iter  80 value 19.458878
```

```
## iter  90 value 19.452773
## iter 100 value 19.450873
## final  value 19.450873
## stopped after 100 iterations
## # weights:  19
## initial  value 114.625659
## iter  10 value 30.221738
## iter  20 value 18.238989
## iter  30 value 12.355188
## iter  40 value 6.181462
## iter  50 value 5.869243
## iter  60 value 5.827340
## iter  70 value 5.810318
## iter  80 value 5.756168
## iter  90 value 5.736558
## iter 100 value 5.713110
## final  value 5.713110
## stopped after 100 iterations
## # weights:  37
## initial  value 129.542443
## iter  10 value 16.650907
## iter  20 value 4.997697
## iter  30 value 3.823334
## iter  40 value 3.819152
## iter  50 value 3.819087
## final  value 3.819085
## converged
## # weights:  55
## initial  value 117.944730
## iter  10 value 14.894852
## iter  20 value 6.317200
## iter  30 value 4.540407
## iter  40 value 4.498763
## iter  50 value 4.498690
## final  value 4.498681
## converged
## # weights:  73
## initial  value 111.169394
## iter  10 value 18.192950
## iter  20 value 6.434745
## iter  30 value 3.886024
## iter  40 value 2.676677
## iter  50 value 2.531855
## iter  60 value 2.516256
## iter  70 value 2.507644
## iter  80 value 2.505932
## iter  90 value 2.505288
## iter 100 value 2.504190
## final  value 2.504190
## stopped after 100 iterations
## # weights:  91
## initial  value 130.375313
## iter  10 value 21.962292
## iter  20 value 5.589885
```

```
## iter  30 value 0.822973
## iter  40 value 0.013520
## iter  50 value 0.001345
## final  value 0.000071
## converged
## # weights:  109
## initial  value 118.750607
## iter  10 value 15.146031
## iter  20 value 1.329264
## iter  30 value 0.011547
## final  value 0.000077
## converged
## # weights:  127
## initial  value 125.485793
## iter  10 value 27.328725
## iter  20 value 6.922176
## iter  30 value 4.464281
## iter  40 value 3.593154
## iter  50 value 3.439433
## iter  60 value 3.201881
## iter  70 value 3.013950
## iter  80 value 2.253420
## iter  90 value 1.913226
## iter 100 value 1.406899
## final  value 1.406899
## stopped after 100 iterations
## # weights:  145
## initial  value 139.582552
## iter  10 value 14.096103
## iter  20 value 0.596927
## iter  30 value 0.001688
## final  value 0.000096
## converged
## # weights:  163
## initial  value 129.515957
## iter  10 value 13.356345
## iter  20 value 0.893988
## iter  30 value 0.016475
## iter  40 value 0.002224
## iter  50 value 0.000457
## final  value 0.000091
## converged
## # weights:  181
## initial  value 132.938345
## iter  10 value 11.304059
## iter  20 value 0.524139
## iter  30 value 0.011814
## iter  40 value 0.000758
## iter  50 value 0.000110
## final  value 0.000098
## converged
## # weights:  199
## initial  value 116.108984
## iter  10 value 15.274547
```

```
## iter  20 value 0.380236
## iter  30 value 0.013499
## iter  40 value 0.001505
## iter  50 value 0.000184
## final  value 0.000074
## converged
## # weights:  217
## initial  value 125.518993
## iter  10 value 10.997071
## iter  20 value 0.234637
## iter  30 value 0.003671
## iter  40 value 0.000122
## final  value 0.000002
## converged
## # weights:  235
## initial  value 166.180280
## iter  10 value 10.685169
## iter  20 value 0.366803
## iter  30 value 0.002439
## iter  40 value 0.000189
## final  value 0.000096
## converged
## # weights:  253
## initial  value 183.495396
## iter  10 value 17.550456
## iter  20 value 2.936631
## iter  30 value 0.041237
## iter  40 value 0.002137
## final  value 0.000055
## converged
## # weights:  271
## initial  value 118.276285
## iter  10 value 7.953221
## iter  20 value 0.224545
## iter  30 value 0.003267
## iter  40 value 0.000670
## iter  50 value 0.000142
## final  value 0.000088
## converged
## # weights:  289
## initial  value 146.730444
## iter  10 value 12.285931
## iter  20 value 0.251497
## iter  30 value 0.008310
## iter  40 value 0.001541
## iter  50 value 0.000317
## iter  60 value 0.000174
## final  value 0.000095
## converged
## # weights:  307
## initial  value 160.266921
## iter  10 value 10.868892
## iter  20 value 0.173825
## iter  30 value 0.000707
```

```
## final  value 0.000083
## converged
## # weights:  325
## initial  value 135.395338
## iter  10 value 14.719700
## iter  20 value 0.960444
## iter  30 value 0.005318
## iter  40 value 0.000139
## final  value 0.000096
## converged
## # weights:  19
## initial  value 113.214728
## iter  10 value 31.361239
## iter  20 value 27.557379
## iter  30 value 25.342802
## final  value 25.341324
## converged
## # weights:  37
## initial  value 116.796050
## iter  10 value 44.371257
## iter  20 value 29.692129
## iter  30 value 24.735941
## iter  40 value 21.365951
## iter  50 value 20.266007
## iter  60 value 19.892109
## iter  70 value 19.831344
## iter  80 value 19.822169
## iter  90 value 19.642813
## iter 100 value 19.532185
## final  value 19.532185
## stopped after 100 iterations
## # weights:  55
## initial  value 112.303241
## iter  10 value 25.735814
## iter  20 value 19.529134
## iter  30 value 17.514457
## iter  40 value 17.405769
## iter  50 value 17.402668
## iter  60 value 17.401879
## final  value 17.401876
## converged
## # weights:  73
## initial  value 122.193427
## iter  10 value 21.495675
## iter  20 value 16.580867
## iter  30 value 15.104967
## iter  40 value 14.956409
## iter  50 value 14.920769
## iter  60 value 14.920186
## iter  70 value 14.920155
## final  value 14.920152
## converged
## # weights:  91
## initial  value 115.822201
```

```
## iter  10 value 20.384546
## iter  20 value 16.227503
## iter  30 value 14.654663
## iter  40 value 14.428732
## iter  50 value 14.320332
## iter  60 value 14.306682
## iter  70 value 14.304774
## final  value 14.304706
## converged
## # weights:  109
## initial  value 111.970590
## iter  10 value 22.686645
## iter  20 value 17.107909
## iter  30 value 15.329980
## iter  40 value 14.895803
## iter  50 value 14.409271
## iter  60 value 14.271633
## iter  70 value 14.227306
## iter  80 value 14.222857
## iter  90 value 14.217648
## iter 100 value 14.188470
## final  value 14.188470
## stopped after 100 iterations
## # weights:  127
## initial  value 124.664749
## iter  10 value 20.649400
## iter  20 value 14.780768
## iter  30 value 14.088207
## iter  40 value 13.868848
## iter  50 value 13.444975
## iter  60 value 13.375110
## iter  70 value 13.354626
## iter  80 value 13.321330
## iter  90 value 13.308951
## iter 100 value 13.306966
## final  value 13.306966
## stopped after 100 iterations
## # weights:  145
## initial  value 132.993655
## iter  10 value 25.991266
## iter  20 value 15.997053
## iter  30 value 14.579369
## iter  40 value 14.016833
## iter  50 value 13.756725
## iter  60 value 13.674142
## iter  70 value 13.655022
## iter  80 value 13.459179
## iter  90 value 13.398497
## iter 100 value 13.391350
## final  value 13.391350
## stopped after 100 iterations
## # weights:  163
## initial  value 123.567600
## iter  10 value 20.792007
```

```
## iter  20 value 15.321734
## iter  30 value 14.018411
## iter  40 value 13.832745
## iter  50 value 13.758268
## iter  60 value 13.378519
## iter  70 value 13.136204
## iter  80 value 13.078644
## iter  90 value 13.062400
## iter 100 value 13.052603
## final  value 13.052603
## stopped after 100 iterations
## # weights:  181
## initial  value 125.117338
## iter  10 value 23.314757
## iter  20 value 15.980657
## iter  30 value 14.075766
## iter  40 value 13.629693
## iter  50 value 13.453346
## iter  60 value 13.185160
## iter  70 value 13.088833
## iter  80 value 13.048615
## iter  90 value 13.020192
## iter 100 value 13.005453
## final  value 13.005453
## stopped after 100 iterations
## # weights:  199
## initial  value 188.056932
## iter  10 value 21.524920
## iter  20 value 14.739247
## iter  30 value 13.511974
## iter  40 value 13.335807
## iter  50 value 13.251697
## iter  60 value 13.163270
## iter  70 value 13.026876
## iter  80 value 13.012084
## iter  90 value 13.006001
## iter 100 value 12.995568
## final  value 12.995568
## stopped after 100 iterations
## # weights:  217
## initial  value 143.574697
## iter  10 value 21.000032
## iter  20 value 14.701750
## iter  30 value 13.701566
## iter  40 value 13.270022
## iter  50 value 13.191237
## iter  60 value 13.093748
## iter  70 value 13.008912
## iter  80 value 12.988794
## iter  90 value 12.983103
## iter 100 value 12.981166
## final  value 12.981166
## stopped after 100 iterations
## # weights:  235
```

```
## initial  value 130.165920
## iter  10 value 36.362732
## iter  20 value 17.128054
## iter  30 value 14.210060
## iter  40 value 13.401827
## iter  50 value 13.170295
## iter  60 value 13.012260
## iter  70 value 12.956936
## iter  80 value 12.923077
## iter  90 value 12.911544
## iter 100 value 12.908794
## final  value 12.908794
## stopped after 100 iterations
## # weights:  253
## initial  value 130.666052
## iter  10 value 20.584994
## iter  20 value 14.464406
## iter  30 value 13.428811
## iter  40 value 13.146176
## iter  50 value 13.030753
## iter  60 value 12.993832
## iter  70 value 12.973938
## iter  80 value 12.968455
## iter  90 value 12.963416
## iter 100 value 12.962438
## final  value 12.962438
## stopped after 100 iterations
## # weights:  271
## initial  value 114.177319
## iter  10 value 21.526838
## iter  20 value 14.777642
## iter  30 value 13.711456
## iter  40 value 13.235936
## iter  50 value 13.050933
## iter  60 value 12.960988
## iter  70 value 12.948124
## iter  80 value 12.944829
## iter  90 value 12.944316
## iter 100 value 12.943823
## final  value 12.943823
## stopped after 100 iterations
## # weights:  289
## initial  value 118.781834
## iter  10 value 20.271769
## iter  20 value 14.601154
## iter  30 value 13.665463
## iter  40 value 13.185346
## iter  50 value 13.031336
## iter  60 value 12.989194
## iter  70 value 12.969013
## iter  80 value 12.946534
## iter  90 value 12.932547
## iter 100 value 12.929511
## final  value 12.929511
```

```
## stopped after 100 iterations
## # weights:  307
## initial  value 120.335396
## iter  10 value 24.135695
## iter  20 value 15.306396
## iter  30 value 13.680223
## iter  40 value 13.108137
## iter  50 value 12.933082
## iter  60 value 12.896942
## iter  70 value 12.877991
## iter  80 value 12.872322
## iter  90 value 12.867661
## iter 100 value 12.865770
## final  value 12.865770
## stopped after 100 iterations
## # weights:  325
## initial  value 144.118545
## iter  10 value 23.154634
## iter  20 value 15.617275
## iter  30 value 14.004266
## iter  40 value 13.339107
## iter  50 value 13.178326
## iter  60 value 13.131976
## iter  70 value 13.105774
## iter  80 value 13.026998
## iter  90 value 12.957359
## iter 100 value 12.950668
## final  value 12.950668
## stopped after 100 iterations
## # weights:  19
## initial  value 115.166065
## iter  10 value 48.861348
## iter  20 value 33.675304
## iter  30 value 31.156996
## iter  40 value 31.125455
## final  value 31.125445
## converged
## # weights:  37
## initial  value 131.308178
## iter  10 value 33.801225
## iter  20 value 25.367527
## iter  30 value 24.518815
## iter  40 value 24.036881
## iter  50 value 23.728034
## iter  60 value 23.576067
## final  value 23.575925
## converged
## # weights:  55
## initial  value 128.127259
## iter  10 value 41.857862
## iter  20 value 26.243052
## iter  30 value 22.454429
## iter  40 value 22.103004
## iter  50 value 22.067185
```

```
## iter  60 value 22.066222
## final  value 22.066221
## converged
## # weights:  73
## initial  value 123.551876
## iter  10 value 33.882910
## iter  20 value 25.435484
## iter  30 value 24.216509
## iter  40 value 21.536518
## iter  50 value 21.016623
## iter  60 value 20.988206
## iter  70 value 20.987039
## final  value 20.987033
## converged
## # weights:  91
## initial  value 154.645373
## iter  10 value 29.846722
## iter  20 value 23.455145
## iter  30 value 22.058891
## iter  40 value 21.475881
## iter  50 value 21.426569
## iter  60 value 20.945143
## iter  70 value 20.901450
## iter  80 value 20.897865
## iter  90 value 20.897831
## final  value 20.897830
## converged
## # weights:  109
## initial  value 110.298789
## iter  10 value 27.959512
## iter  20 value 21.129953
## iter  30 value 20.665336
## iter  40 value 20.476730
## iter  50 value 20.168343
## iter  60 value 20.143146
## iter  70 value 20.142778
## final  value 20.142776
## converged
## # weights:  127
## initial  value 119.102802
## iter  10 value 35.843348
## iter  20 value 22.560507
## iter  30 value 20.970861
## iter  40 value 20.707504
## iter  50 value 20.409761
## iter  60 value 20.277551
## iter  70 value 20.272560
## iter  80 value 20.271865
## iter  90 value 20.271840
## iter  90 value 20.271840
## iter  90 value 20.271840
## final  value 20.271840
## converged
## # weights:  145
```

```
## initial  value 134.566050
## iter  10 value 25.715340
## iter  20 value 22.079581
## iter  30 value 20.913932
## iter  40 value 20.420003
## iter  50 value 20.109145
## iter  60 value 20.064960
## iter  70 value 20.050610
## iter  80 value 20.004044
## iter  90 value 19.997102
## iter 100 value 19.995893
## final  value 19.995893
## stopped after 100 iterations
## # weights:  163
## initial  value 135.678687
## iter  10 value 32.690039
## iter  20 value 22.650079
## iter  30 value 21.036546
## iter  40 value 20.545934
## iter  50 value 20.230718
## iter  60 value 20.152912
## iter  70 value 20.108610
## iter  80 value 20.022436
## iter  90 value 19.994960
## iter 100 value 19.991769
## final  value 19.991769
## stopped after 100 iterations
## # weights:  181
## initial  value 150.323426
## iter  10 value 29.495208
## iter  20 value 22.470172
## iter  30 value 20.796175
## iter  40 value 20.385635
## iter  50 value 20.146421
## iter  60 value 20.081000
## iter  70 value 19.974720
## iter  80 value 19.919969
## iter  90 value 19.905478
## iter 100 value 19.891600
## final  value 19.891600
## stopped after 100 iterations
## # weights:  199
## initial  value 131.741768
## iter  10 value 26.995226
## iter  20 value 21.798792
## iter  30 value 20.811926
## iter  40 value 20.411875
## iter  50 value 20.134488
## iter  60 value 19.929566
## iter  70 value 19.898553
## iter  80 value 19.883247
## iter  90 value 19.853574
## iter 100 value 19.847058
## final  value 19.847058
```

```
## stopped after 100 iterations
## # weights:  217
## initial  value 121.912431
## iter  10 value 37.643714
## iter  20 value 22.050500
## iter  30 value 20.634239
## iter  40 value 20.240922
## iter  50 value 19.900069
## iter  60 value 19.846858
## iter  70 value 19.826004
## iter  80 value 19.821053
## iter  90 value 19.817254
## iter 100 value 19.815862
## final  value 19.815862
## stopped after 100 iterations
## # weights:  235
## initial  value 117.930404
## iter  10 value 25.805212
## iter  20 value 20.957794
## iter  30 value 20.309585
## iter  40 value 20.094947
## iter  50 value 19.936995
## iter  60 value 19.817572
## iter  70 value 19.790037
## iter  80 value 19.784353
## iter  90 value 19.779905
## iter 100 value 19.778074
## final  value 19.778074
## stopped after 100 iterations
## # weights:  253
## initial  value 173.455698
## iter  10 value 27.507665
## iter  20 value 21.088046
## iter  30 value 20.513998
## iter  40 value 20.131083
## iter  50 value 19.896786
## iter  60 value 19.832566
## iter  70 value 19.808059
## iter  80 value 19.805152
## iter  90 value 19.804804
## iter 100 value 19.804581
## final  value 19.804581
## stopped after 100 iterations
## # weights:  271
## initial  value 158.570973
## iter  10 value 31.493373
## iter  20 value 20.958508
## iter  30 value 20.227881
## iter  40 value 19.947587
## iter  50 value 19.846997
## iter  60 value 19.808100
## iter  70 value 19.797887
## iter  80 value 19.790562
## iter  90 value 19.787085
```

```
## iter 100 value 19.786189
## final  value 19.786189
## stopped after 100 iterations
## # weights:  289
## initial  value 154.178073
## iter  10 value 26.152250
## iter  20 value 20.655501
## iter  30 value 20.155064
## iter  40 value 20.011819
## iter  50 value 19.972777
## iter  60 value 19.963104
## iter  70 value 19.960282
## iter  80 value 19.958482
## iter  90 value 19.957651
## iter 100 value 19.957347
## final  value 19.957347
## stopped after 100 iterations
## # weights:  307
## initial  value 110.941836
## iter  10 value 28.371781
## iter  20 value 20.826481
## iter  30 value 20.121839
## iter  40 value 19.921766
## iter  50 value 19.868175
## iter  60 value 19.831225
## iter  70 value 19.824702
## iter  80 value 19.814975
## iter  90 value 19.812219
## iter 100 value 19.810951
## final  value 19.810951
## stopped after 100 iterations
## # weights:  325
## initial  value 104.937700
## iter  10 value 32.481538
## iter  20 value 21.161200
## iter  30 value 20.359609
## iter  40 value 20.013217
## iter  50 value 19.851035
## iter  60 value 19.804658
## iter  70 value 19.789855
## iter  80 value 19.787501
## iter  90 value 19.776320
## iter 100 value 19.773424
## final  value 19.773424
## stopped after 100 iterations
## # weights:  19
## initial  value 124.235828
## iter  10 value 21.409864
## iter  20 value 17.162987
## iter  30 value 16.277366
## iter  40 value 16.272139
## iter  50 value 16.271911
## iter  50 value 16.271911
## iter  50 value 16.271911
```

```
## final  value 16.271911
## converged
## # weights:  37
## initial  value 117.163477
## iter  10 value 21.404906
## iter  20 value 6.153460
## iter  30 value 3.866412
## iter  40 value 3.820043
## iter  50 value 3.819167
## iter  60 value 3.819089
## final  value 3.819086
## converged
## # weights:  55
## initial  value 122.503255
## iter  10 value 28.073586
## iter  20 value 16.913317
## iter  30 value 11.282362
## iter  40 value 9.376140
## iter  50 value 6.638842
## iter  60 value 4.623342
## iter  70 value 3.497954
## iter  80 value 2.865006
## iter  90 value 2.356024
## iter 100 value 1.994620
## final  value 1.994620
## stopped after 100 iterations
## # weights:  73
## initial  value 128.968372
## iter  10 value 18.319533
## iter  20 value 0.670184
## iter  30 value 0.009789
## iter  40 value 0.000329
## final  value 0.000075
## converged
## # weights:  91
## initial  value 119.191110
## iter  10 value 18.420569
## iter  20 value 4.098033
## iter  30 value 2.712026
## iter  40 value 2.702590
## iter  50 value 2.701146
## iter  60 value 2.502588
## iter  70 value 2.501115
## iter  80 value 2.456000
## iter  90 value 2.258122
## iter 100 value 2.250118
## final  value 2.250118
## stopped after 100 iterations
## # weights:  109
## initial  value 122.214253
## iter  10 value 17.810092
## iter  20 value 6.643649
## iter  30 value 3.798860
## iter  40 value 3.551380
```

```
## iter  50 value 3.521975
## iter  60 value 3.511049
## iter  70 value 2.282633
## iter  80 value 2.250040
## iter  90 value 1.887898
## iter 100 value 1.399358
## final  value 1.399358
## stopped after 100 iterations
## # weights:  127
## initial  value 130.965689
## iter  10 value 16.926123
## iter  20 value 2.843163
## iter  30 value 1.395848
## iter  40 value 1.386858
## iter  50 value 1.386380
## iter  60 value 1.386333
## final  value 1.386294
## converged
## # weights:  145
## initial  value 120.821503
## iter  10 value 16.407068
## iter  20 value 1.229344
## iter  30 value 0.009242
## iter  40 value 0.000406
## final  value 0.000083
## converged
## # weights:  163
## initial  value 113.610978
## iter  10 value 12.532187
## iter  20 value 0.851045
## iter  30 value 0.021888
## iter  40 value 0.000255
## iter  50 value 0.000118
## iter  50 value 0.000047
## iter  50 value 0.000044
## final  value 0.000044
## converged
## # weights:  181
## initial  value 139.493291
## iter  10 value 16.499762
## iter  20 value 0.722840
## iter  30 value 0.010105
## iter  40 value 0.000265
## final  value 0.000093
## converged
## # weights:  199
## initial  value 123.811035
## iter  10 value 14.149681
## iter  20 value 1.303607
## iter  30 value 0.010013
## iter  40 value 0.001499
## iter  50 value 0.000178
## iter  60 value 0.000101
## iter  60 value 0.000092
```

```
## iter  60 value 0.000092
## final  value 0.000092
## converged
## # weights:  217
## initial  value 148.580015
## iter  10 value 14.747375
## iter  20 value 0.454338
## iter  30 value 0.007830
## iter  40 value 0.000833
## iter  50 value 0.000118
## iter  50 value 0.000060
## iter  50 value 0.000060
## final  value 0.000060
## converged
## # weights:  235
## initial  value 148.194429
## iter  10 value 16.745526
## iter  20 value 0.367059
## iter  30 value 0.002990
## iter  40 value 0.000144
## iter  40 value 0.000094
## iter  40 value 0.000094
## final  value 0.000094
## converged
## # weights:  253
## initial  value 130.777390
## iter  10 value 19.613078
## iter  20 value 0.599560
## iter  30 value 0.004451
## iter  40 value 0.000305
## final  value 0.000097
## converged
## # weights:  271
## initial  value 154.477465
## iter  10 value 18.661915
## iter  20 value 1.568984
## iter  30 value 0.024330
## iter  40 value 0.001585
## iter  50 value 0.000402
## final  value 0.000099
## converged
## # weights:  289
## initial  value 122.651408
## iter  10 value 12.734398
## iter  20 value 0.280003
## iter  30 value 0.006929
## iter  40 value 0.000213
## final  value 0.000098
## converged
## # weights:  307
## initial  value 117.448052
## iter  10 value 11.424709
## iter  20 value 0.308294
## iter  30 value 0.012793
```

```
## iter  40 value 0.001354
## iter  50 value 0.000199
## final  value 0.000097
## converged
## # weights:  325
## initial  value 116.867031
## iter  10 value 13.773627
## iter  20 value 0.151285
## iter  30 value 0.006016
## iter  40 value 0.000198
## final  value 0.000099
## converged
## # weights:  19
## initial  value 133.066577
## iter  10 value 61.090474
## iter  20 value 27.757673
## iter  30 value 26.359460
## iter  40 value 26.307744
## iter  50 value 26.307642
## final  value 26.307637
## converged
## # weights:  37
## initial  value 117.202311
## iter  10 value 34.788424
## iter  20 value 19.831617
## iter  30 value 18.774844
## iter  40 value 18.717530
## final  value 18.717011
## converged
## # weights:  55
## initial  value 128.820109
## iter  10 value 32.461077
## iter  20 value 20.864151
## iter  30 value 17.507614
## iter  40 value 16.425477
## iter  50 value 16.390763
## iter  60 value 16.388633
## final  value 16.388626
## converged
## # weights:  73
## initial  value 134.439576
## iter  10 value 41.939242
## iter  20 value 26.173815
## iter  30 value 19.613367
## iter  40 value 16.722231
## iter  50 value 16.223387
## iter  60 value 15.609460
## iter  70 value 15.380516
## iter  80 value 15.362330
## iter  90 value 15.362231
## final  value 15.362229
## converged
## # weights:  91
## initial  value 121.692299
```

```
## iter  10 value 30.405899
## iter  20 value 19.674214
## iter  30 value 17.414148
## iter  40 value 16.231689
## iter  50 value 15.419719
## iter  60 value 15.205924
## iter  70 value 15.130788
## iter  80 value 14.874123
## iter  90 value 14.672088
## iter 100 value 14.665108
## final  value 14.665108
## stopped after 100 iterations
## # weights:  109
## initial  value 126.705990
## iter  10 value 29.469177
## iter  20 value 18.459355
## iter  30 value 16.523929
## iter  40 value 15.371112
## iter  50 value 15.046181
## iter  60 value 14.800942
## iter  70 value 14.728828
## iter  80 value 14.723031
## iter  90 value 14.720764
## iter 100 value 14.720305
## final  value 14.720305
## stopped after 100 iterations
## # weights:  127
## initial  value 120.947626
## iter  10 value 31.551246
## iter  20 value 18.795981
## iter  30 value 16.756108
## iter  40 value 15.853027
## iter  50 value 15.291085
## iter  60 value 15.048215
## iter  70 value 14.948304
## iter  80 value 14.804231
## iter  90 value 14.786648
## iter 100 value 14.785988
## final  value 14.785988
## stopped after 100 iterations
## # weights:  145
## initial  value 121.397948
## iter  10 value 23.882004
## iter  20 value 17.296978
## iter  30 value 14.996467
## iter  40 value 14.353884
## iter  50 value 14.105938
## iter  60 value 14.046529
## iter  70 value 14.022291
## iter  80 value 14.010203
## iter  90 value 14.003172
## iter 100 value 14.002084
## final  value 14.002084
## stopped after 100 iterations
```

```
## # weights:  163
## initial  value 181.154661
## iter  10 value 52.400381
## iter  20 value 21.860485
## iter  30 value 16.964814
## iter  40 value 15.218007
## iter  50 value 14.349497
## iter  60 value 14.144837
## iter  70 value 14.101014
## iter  80 value 14.046647
## iter  90 value 14.033352
## iter 100 value 14.005782
## final  value 14.005782
## stopped after 100 iterations
## # weights:  181
## initial  value 131.220183
## iter  10 value 22.786406
## iter  20 value 15.438672
## iter  30 value 14.523597
## iter  40 value 14.245961
## iter  50 value 14.043865
## iter  60 value 13.948981
## iter  70 value 13.930312
## iter  80 value 13.919650
## iter  90 value 13.905582
## iter 100 value 13.902629
## final  value 13.902629
## stopped after 100 iterations
## # weights:  199
## initial  value 140.819099
## iter  10 value 26.951830
## iter  20 value 16.939830
## iter  30 value 15.062701
## iter  40 value 14.468055
## iter  50 value 14.273197
## iter  60 value 14.150873
## iter  70 value 14.123090
## iter  80 value 14.052711
## iter  90 value 14.017940
## iter 100 value 14.004957
## final  value 14.004957
## stopped after 100 iterations
## # weights:  217
## initial  value 146.806546
## iter  10 value 27.976227
## iter  20 value 17.388408
## iter  30 value 14.757068
## iter  40 value 14.266045
## iter  50 value 14.044825
## iter  60 value 13.987052
## iter  70 value 13.956433
## iter  80 value 13.922824
## iter  90 value 13.917199
## iter 100 value 13.915126
```

```
## final  value 13.915126
## stopped after 100 iterations
## # weights:  235
## initial  value 136.590680
## iter  10 value 23.061462
## iter  20 value 16.249991
## iter  30 value 14.530406
## iter  40 value 14.144067
## iter  50 value 13.999565
## iter  60 value 13.951738
## iter  70 value 13.937690
## iter  80 value 13.923622
## iter  90 value 13.905430
## iter 100 value 13.882201
## final  value 13.882201
## stopped after 100 iterations
## # weights:  253
## initial  value 153.593205
## iter  10 value 30.161666
## iter  20 value 16.808071
## iter  30 value 14.924394
## iter  40 value 14.254289
## iter  50 value 14.087951
## iter  60 value 13.981167
## iter  70 value 13.921072
## iter  80 value 13.868759
## iter  90 value 13.847160
## iter 100 value 13.840345
## final  value 13.840345
## stopped after 100 iterations
## # weights:  271
## initial  value 103.503351
## iter  10 value 21.927809
## iter  20 value 15.610569
## iter  30 value 14.489171
## iter  40 value 14.008217
## iter  50 value 13.907966
## iter  60 value 13.881135
## iter  70 value 13.871538
## iter  80 value 13.868955
## iter  90 value 13.868227
## iter 100 value 13.868090
## final  value 13.868090
## stopped after 100 iterations
## # weights:  289
## initial  value 125.838372
## iter  10 value 23.974913
## iter  20 value 15.693987
## iter  30 value 14.403512
## iter  40 value 13.968112
## iter  50 value 13.858779
## iter  60 value 13.832193
## iter  70 value 13.815670
## iter  80 value 13.811220
```

```
## iter  90 value 13.807922
## iter 100 value 13.806371
## final  value 13.806371
## stopped after 100 iterations
## # weights:  307
## initial  value 134.752490
## iter  10 value 21.209425
## iter  20 value 15.700906
## iter  30 value 14.785540
## iter  40 value 14.317075
## iter  50 value 14.050077
## iter  60 value 13.978368
## iter  70 value 13.950017
## iter  80 value 13.907988
## iter  90 value 13.884543
## iter 100 value 13.874430
## final  value 13.874430
## stopped after 100 iterations
## # weights:  325
## initial  value 133.983883
## iter  10 value 20.671642
## iter  20 value 15.144350
## iter  30 value 14.287441
## iter  40 value 14.075318
## iter  50 value 13.948499
## iter  60 value 13.887786
## iter  70 value 13.866027
## iter  80 value 13.860500
## iter  90 value 13.858798
## iter 100 value 13.858163
## final  value 13.858163
## stopped after 100 iterations
## # weights:  19
## initial  value 120.986029
## iter  10 value 36.298895
## iter  20 value 31.692108
## iter  30 value 31.658096
## final  value 31.658093
## converged
## # weights:  37
## initial  value 115.296791
## iter  10 value 32.878833
## iter  20 value 26.578330
## iter  30 value 26.048866
## iter  40 value 25.950451
## iter  50 value 25.950371
## final  value 25.950369
## converged
## # weights:  55
## initial  value 130.439827
## iter  10 value 37.416026
## iter  20 value 27.100593
## iter  30 value 26.228668
## iter  40 value 25.956922
```

```
## iter  50 value 25.876599
## iter  60 value 25.875351
## final  value 25.875350
## converged
## # weights:  73
## initial  value 155.604746
## iter  10 value 40.130060
## iter  20 value 28.627746
## iter  30 value 26.490127
## iter  40 value 24.342238
## iter  50 value 23.372727
## iter  60 value 22.700116
## iter  70 value 22.496457
## iter  80 value 22.426030
## iter  90 value 22.367293
## iter 100 value 22.355196
## final  value 22.355196
## stopped after 100 iterations
## # weights:  91
## initial  value 114.995672
## iter  10 value 32.824809
## iter  20 value 24.498138
## iter  30 value 23.304554
## iter  40 value 22.451584
## iter  50 value 22.292060
## iter  60 value 22.290994
## iter  70 value 22.290910
## final  value 22.290907
## converged
## # weights:  109
## initial  value 124.883061
## iter  10 value 28.354388
## iter  20 value 24.162396
## iter  30 value 23.047645
## iter  40 value 22.670576
## iter  50 value 22.583315
## iter  60 value 22.540245
## iter  70 value 22.532540
## iter  80 value 22.532323
## iter  90 value 22.532304
## iter 100 value 22.532291
## final  value 22.532291
## stopped after 100 iterations
## # weights:  127
## initial  value 135.981956
## iter  10 value 42.094468
## iter  20 value 25.546864
## iter  30 value 22.890546
## iter  40 value 22.413347
## iter  50 value 22.266884
## iter  60 value 22.205339
## iter  70 value 22.119551
## iter  80 value 21.807131
## iter  90 value 21.471943
```

```
## iter 100 value 21.409856
## final  value 21.409856
## stopped after 100 iterations
## # weights:  145
## initial  value 130.667217
## iter  10 value 28.423159
## iter  20 value 23.038399
## iter  30 value 22.203434
## iter  40 value 21.816886
## iter  50 value 21.547698
## iter  60 value 21.288365
## iter  70 value 21.265512
## iter  80 value 21.260115
## iter  90 value 21.258989
## iter 100 value 21.258697
## final  value 21.258697
## stopped after 100 iterations
## # weights:  163
## initial  value 131.279129
## iter  10 value 30.399146
## iter  20 value 22.603616
## iter  30 value 21.520434
## iter  40 value 21.322532
## iter  50 value 21.243479
## iter  60 value 21.179916
## iter  70 value 21.173981
## iter  80 value 21.173114
## iter  90 value 21.169909
## iter 100 value 21.159215
## final  value 21.159215
## stopped after 100 iterations
## # weights:  181
## initial  value 138.846073
## iter  10 value 34.821699
## iter  20 value 23.559321
## iter  30 value 22.219822
## iter  40 value 21.732114
## iter  50 value 21.331798
## iter  60 value 21.200053
## iter  70 value 21.145473
## iter  80 value 21.133637
## iter  90 value 21.133057
## iter 100 value 21.132864
## final  value 21.132864
## stopped after 100 iterations
## # weights:  199
## initial  value 132.822491
## iter  10 value 28.047432
## iter  20 value 22.628699
## iter  30 value 21.734092
## iter  40 value 21.656089
## iter  50 value 21.635500
## iter  60 value 21.602456
## iter  70 value 21.591712
```

```
## iter  80 value 21.583463
## iter  90 value 21.573718
## iter 100 value 21.569832
## final  value 21.569832
## stopped after 100 iterations
## # weights:  217
## initial  value 147.914561
## iter  10 value 33.356542
## iter  20 value 22.165153
## iter  30 value 21.632184
## iter  40 value 21.511944
## iter  50 value 21.257194
## iter  60 value 21.158943
## iter  70 value 21.123621
## iter  80 value 21.117000
## iter  90 value 21.116241
## iter 100 value 21.115823
## final  value 21.115823
## stopped after 100 iterations
## # weights:  235
## initial  value 151.429396
## iter  10 value 36.127167
## iter  20 value 23.091757
## iter  30 value 21.843125
## iter  40 value 21.351325
## iter  50 value 21.204275
## iter  60 value 21.137156
## iter  70 value 21.103872
## iter  80 value 21.081399
## iter  90 value 21.050214
## iter 100 value 21.035445
## final  value 21.035445
## stopped after 100 iterations
## # weights:  253
## initial  value 142.269644
## iter  10 value 34.928036
## iter  20 value 24.247420
## iter  30 value 22.011101
## iter  40 value 21.484367
## iter  50 value 21.278976
## iter  60 value 21.207197
## iter  70 value 21.177737
## iter  80 value 21.168699
## iter  90 value 21.167583
## iter 100 value 21.167034
## final  value 21.167034
## stopped after 100 iterations
## # weights:  271
## initial  value 148.734335
## iter  10 value 26.873300
## iter  20 value 22.024110
## iter  30 value 21.354409
## iter  40 value 21.123951
## iter  50 value 21.082925
```

```
## iter  60 value 21.064987
## iter  70 value 21.050400
## iter  80 value 21.041796
## iter  90 value 21.041076
## iter 100 value 21.040995
## final  value 21.040995
## stopped after 100 iterations
## # weights:  289
## initial  value 121.989307
## iter  10 value 25.837258
## iter  20 value 22.471394
## iter  30 value 21.641067
## iter  40 value 21.399259
## iter  50 value 21.221762
## iter  60 value 21.147025
## iter  70 value 21.134828
## iter  80 value 21.129299
## iter  90 value 21.127249
## iter 100 value 21.126397
## final  value 21.126397
## stopped after 100 iterations
## # weights:  307
## initial  value 128.573582
## iter  10 value 33.450584
## iter  20 value 22.940348
## iter  30 value 22.116117
## iter  40 value 21.483760
## iter  50 value 21.267061
## iter  60 value 21.151739
## iter  70 value 21.117402
## iter  80 value 21.100297
## iter  90 value 21.068452
## iter 100 value 21.064104
## final  value 21.064104
## stopped after 100 iterations
## # weights:  325
## initial  value 108.282370
## iter  10 value 32.681269
## iter  20 value 22.878718
## iter  30 value 21.740022
## iter  40 value 21.369370
## iter  50 value 21.204326
## iter  60 value 21.147845
## iter  70 value 21.095209
## iter  80 value 21.070835
## iter  90 value 21.039474
## iter 100 value 21.035628
## final  value 21.035628
## stopped after 100 iterations
## # weights:  19
## initial  value 116.131758
## iter  10 value 23.929892
## iter  20 value 14.546000
## iter  30 value 11.462413
```

```
## iter  40 value 9.655383
## iter  50 value 8.343241
## iter  60 value 7.574904
## iter  70 value 6.956725
## iter  80 value 6.642903
## iter  90 value 6.588994
## iter 100 value 6.509563
## final  value 6.509563
## stopped after 100 iterations
## # weights:  37
## initial  value 121.955929
## iter  10 value 25.448749
## iter  20 value 17.073052
## iter  30 value 13.660872
## iter  40 value 12.323324
## iter  50 value 11.649891
## iter  60 value 11.388514
## iter  70 value 11.385122
## iter  80 value 11.384849
## final  value 11.384801
## converged
## # weights:  55
## initial  value 127.092837
## iter  10 value 17.665278
## iter  20 value 6.483443
## iter  30 value 3.840515
## iter  40 value 3.819185
## iter  50 value 3.819093
## final  value 3.819085
## converged
## # weights:  73
## initial  value 140.455930
## iter  10 value 14.798409
## iter  20 value 5.959506
## iter  30 value 1.487881
## iter  40 value 1.388875
## iter  50 value 1.386697
## iter  60 value 1.386507
## iter  70 value 1.386449
## iter  80 value 1.386375
## iter  90 value 1.386299
## final  value 1.386294
## converged
## # weights:  91
## initial  value 118.093234
## iter  10 value 12.814738
## iter  20 value 0.632314
## iter  30 value 0.005418
## final  value 0.000064
## converged
## # weights:  109
## initial  value 114.888943
## iter  10 value 13.135415
## iter  20 value 0.330001
```

```
## iter  30 value 0.002523
## iter  40 value 0.000113
## final  value 0.000086
## converged
## # weights:  127
## initial  value 130.476804
## iter  10 value 17.698715
## iter  20 value 2.141283
## iter  30 value 0.028354
## iter  40 value 0.000579
## final  value 0.000099
## converged
## # weights:  145
## initial  value 141.548355
## iter  10 value 24.218165
## iter  20 value 5.278036
## iter  30 value 1.981387
## iter  40 value 1.910710
## iter  50 value 1.909563
## iter  60 value 1.909543
## iter  60 value 1.909543
## final  value 1.909543
## converged
## # weights:  163
## initial  value 112.227733
## iter  10 value 13.023335
## iter  20 value 2.253147
## iter  30 value 0.012117
## iter  40 value 0.000991
## iter  50 value 0.000157
## iter  50 value 0.000091
## iter  50 value 0.000091
## final  value 0.000091
## converged
## # weights:  181
## initial  value 135.678860
## iter  10 value 12.435753
## iter  20 value 1.433368
## iter  30 value 0.018184
## iter  40 value 0.000957
## iter  50 value 0.000185
## final  value 0.000065
## converged
## # weights:  199
## initial  value 98.977690
## iter  10 value 12.064182
## iter  20 value 0.173839
## iter  30 value 0.001183
## final  value 0.000069
## converged
## # weights:  217
## initial  value 107.402591
## iter  10 value 11.903870
## iter  20 value 1.174708
```

```
## iter  30 value 0.011203
## iter  40 value 0.001973
## iter  50 value 0.000452
## final  value 0.000056
## converged
## # weights:  235
## initial  value 109.068889
## iter  10 value 16.701968
## iter  20 value 1.930934
## iter  30 value 0.024223
## iter  40 value 0.001701
## iter  50 value 0.000139
## final  value 0.000073
## converged
## # weights:  253
## initial  value 115.446560
## iter  10 value 13.001731
## iter  20 value 1.472911
## iter  30 value 0.024354
## iter  40 value 0.000663
## iter  50 value 0.000118
## final  value 0.000096
## converged
## # weights:  271
## initial  value 205.547359
## iter  10 value 20.110535
## iter  20 value 1.775968
## iter  30 value 0.028206
## iter  40 value 0.001328
## iter  50 value 0.000239
## final  value 0.000072
## converged
## # weights:  289
## initial  value 183.887476
## iter  10 value 21.105010
## iter  20 value 1.657784
## iter  30 value 0.013460
## iter  40 value 0.001180
## iter  50 value 0.000346
## final  value 0.000081
## converged
## # weights:  307
## initial  value 140.769035
## iter  10 value 14.212790
## iter  20 value 1.758908
## iter  30 value 0.011456
## iter  40 value 0.000304
## final  value 0.000088
## converged
## # weights:  325
## initial  value 126.222605
## iter  10 value 11.323837
## iter  20 value 0.580748
## iter  30 value 0.009335
```

```
## iter  40 value 0.000944
## iter  50 value 0.000148
## final  value 0.000082
## converged
## # weights:  19
## initial  value 117.227392
## iter  10 value 56.841456
## iter  20 value 34.085149
## iter  30 value 26.049959
## iter  40 value 25.894652
## iter  50 value 25.894276
## final  value 25.894256
## converged
## # weights:  37
## initial  value 126.425574
## iter  10 value 45.139781
## iter  20 value 29.406250
## iter  30 value 25.264500
## iter  40 value 22.617097
## iter  50 value 20.493067
## iter  60 value 19.468141
## iter  70 value 19.018851
## iter  80 value 17.965339
## iter  90 value 17.433720
## iter 100 value 17.392674
## final  value 17.392674
## stopped after 100 iterations
## # weights:  55
## initial  value 127.607958
## iter  10 value 31.008052
## iter  20 value 20.076177
## iter  30 value 17.383421
## iter  40 value 16.990500
## iter  50 value 16.880741
## iter  60 value 16.866055
## iter  70 value 16.865241
## final  value 16.865176
## converged
## # weights:  73
## initial  value 140.362341
## iter  10 value 23.560665
## iter  20 value 16.992242
## iter  30 value 15.597049
## iter  40 value 15.449247
## iter  50 value 15.445569
## iter  60 value 15.364634
## iter  70 value 15.251092
## iter  80 value 15.245285
## iter  90 value 15.244925
## final  value 15.244922
## converged
## # weights:  91
## initial  value 121.660463
## iter  10 value 39.179920
```

```
## iter  20 value 18.896330
## iter  30 value 16.000615
## iter  40 value 15.357065
## iter  50 value 14.986161
## iter  60 value 14.601454
## iter  70 value 14.389567
## iter  80 value 14.271150
## iter  90 value 14.206042
## iter 100 value 14.184870
## final  value 14.184870
## stopped after 100 iterations
## # weights:  109
## initial  value 127.212790
## iter  10 value 42.726363
## iter  20 value 18.702450
## iter  30 value 15.648678
## iter  40 value 14.968107
## iter  50 value 14.813626
## iter  60 value 14.683253
## iter  70 value 14.492979
## iter  80 value 14.439339
## iter  90 value 14.373419
## iter 100 value 14.344102
## final  value 14.344102
## stopped after 100 iterations
## # weights:  127
## initial  value 122.541286
## iter  10 value 25.137204
## iter  20 value 17.960382
## iter  30 value 15.244096
## iter  40 value 14.357264
## iter  50 value 14.196847
## iter  60 value 14.138033
## iter  70 value 13.983796
## iter  80 value 13.896056
## iter  90 value 13.841698
## iter 100 value 13.829386
## final  value 13.829386
## stopped after 100 iterations
## # weights:  145
## initial  value 129.809380
## iter  10 value 31.030431
## iter  20 value 19.255153
## iter  30 value 16.496552
## iter  40 value 15.534133
## iter  50 value 15.102239
## iter  60 value 14.673769
## iter  70 value 14.275441
## iter  80 value 14.148244
## iter  90 value 14.027413
## iter 100 value 13.991438
## final  value 13.991438
## stopped after 100 iterations
## # weights:  163
```

```
## initial  value 159.775576
## iter  10 value 24.112879
## iter  20 value 15.993957
## iter  30 value 15.047930
## iter  40 value 14.412558
## iter  50 value 14.201998
## iter  60 value 14.005957
## iter  70 value 13.943370
## iter  80 value 13.913778
## iter  90 value 13.903025
## iter 100 value 13.849549
## final  value 13.849549
## stopped after 100 iterations
## # weights:  181
## initial  value 123.005849
## iter  10 value 24.278711
## iter  20 value 16.989055
## iter  30 value 15.063952
## iter  40 value 14.235979
## iter  50 value 13.979537
## iter  60 value 13.888156
## iter  70 value 13.856985
## iter  80 value 13.838547
## iter  90 value 13.820158
## iter 100 value 13.814997
## final  value 13.814997
## stopped after 100 iterations
## # weights:  199
## initial  value 120.735961
## iter  10 value 21.030703
## iter  20 value 14.825308
## iter  30 value 14.018663
## iter  40 value 13.760123
## iter  50 value 13.551344
## iter  60 value 13.483704
## iter  70 value 13.405231
## iter  80 value 13.381742
## iter  90 value 13.374548
## iter 100 value 13.373220
## final  value 13.373220
## stopped after 100 iterations
## # weights:  217
## initial  value 151.005040
## iter  10 value 22.031535
## iter  20 value 15.474288
## iter  30 value 13.939132
## iter  40 value 13.625430
## iter  50 value 13.522937
## iter  60 value 13.462138
## iter  70 value 13.414045
## iter  80 value 13.404521
## iter  90 value 13.379508
## iter 100 value 13.371722
## final  value 13.371722
```

```
## stopped after 100 iterations
## # weights:  235
## initial  value 144.678755
## iter  10 value 26.240572
## iter  20 value 17.510110
## iter  30 value 14.583085
## iter  40 value 13.895295
## iter  50 value 13.671973
## iter  60 value 13.535904
## iter  70 value 13.482121
## iter  80 value 13.445738
## iter  90 value 13.418783
## iter 100 value 13.405404
## final  value 13.405404
## stopped after 100 iterations
## # weights:  253
## initial  value 140.097308
## iter  10 value 21.205443
## iter  20 value 15.529374
## iter  30 value 14.089398
## iter  40 value 13.570216
## iter  50 value 13.460023
## iter  60 value 13.409862
## iter  70 value 13.372942
## iter  80 value 13.362434
## iter  90 value 13.351506
## iter 100 value 13.346000
## final  value 13.346000
## stopped after 100 iterations
## # weights:  271
## initial  value 154.596586
## iter  10 value 20.933389
## iter  20 value 15.193083
## iter  30 value 14.425186
## iter  40 value 13.975198
## iter  50 value 13.836366
## iter  60 value 13.685198
## iter  70 value 13.592240
## iter  80 value 13.567605
## iter  90 value 13.545777
## iter 100 value 13.540267
## final  value 13.540267
## stopped after 100 iterations
## # weights:  289
## initial  value 111.991794
## iter  10 value 19.546834
## iter  20 value 14.568135
## iter  30 value 13.857030
## iter  40 value 13.646036
## iter  50 value 13.566506
## iter  60 value 13.540520
## iter  70 value 13.526830
## iter  80 value 13.520565
## iter  90 value 13.507385
```

```
## iter 100 value 13.491352
## final  value 13.491352
## stopped after 100 iterations
## # weights:  307
## initial  value 135.731091
## iter  10 value 21.122578
## iter  20 value 15.560473
## iter  30 value 14.083474
## iter  40 value 13.636099
## iter  50 value 13.424946
## iter  60 value 13.380019
## iter  70 value 13.369294
## iter  80 value 13.362824
## iter  90 value 13.361332
## iter 100 value 13.358520
## final  value 13.358520
## stopped after 100 iterations
## # weights:  325
## initial  value 158.318421
## iter  10 value 20.622302
## iter  20 value 14.824136
## iter  30 value 13.969862
## iter  40 value 13.722526
## iter  50 value 13.501875
## iter  60 value 13.416605
## iter  70 value 13.385562
## iter  80 value 13.351136
## iter  90 value 13.342867
## iter 100 value 13.338682
## final  value 13.338682
## stopped after 100 iterations
## # weights:  19
## initial  value 113.795826
## iter  10 value 39.193962
## iter  20 value 31.169190
## iter  30 value 31.094788
## iter  30 value 31.094788
## iter  30 value 31.094788
## final  value 31.094788
## converged
## # weights:  37
## initial  value 124.443382
## iter  10 value 29.939099
## iter  20 value 23.739947
## iter  30 value 23.218414
## iter  40 value 23.185291
## final  value 23.185290
## converged
## # weights:  55
## initial  value 120.516038
## iter  10 value 55.216119
## iter  20 value 28.989854
## iter  30 value 25.914748
## iter  40 value 23.722001
```

```
## iter  50 value 22.720685
## iter  60 value 22.577932
## iter  70 value 22.568600
## iter  80 value 22.568533
## iter  90 value 22.568525
## iter  90 value 22.568525
## iter  90 value 22.568525
## final  value 22.568525
## converged
## # weights:  73
## initial  value 124.392399
## iter  10 value 33.959297
## iter  20 value 23.311817
## iter  30 value 22.493424
## iter  40 value 21.562388
## iter  50 value 21.396453
## iter  60 value 21.390721
## iter  70 value 21.390396
## iter  70 value 21.390396
## iter  70 value 21.390396
## final  value 21.390396
## converged
## # weights:  91
## initial  value 116.263296
## iter  10 value 27.809765
## iter  20 value 21.912157
## iter  30 value 21.293721
## iter  40 value 21.071262
## iter  50 value 21.053725
## iter  60 value 21.037628
## iter  70 value 21.037586
## final  value 21.037586
## converged
## # weights:  109
## initial  value 132.283696
## iter  10 value 34.416139
## iter  20 value 22.118468
## iter  30 value 21.183124
## iter  40 value 21.037684
## iter  50 value 20.966555
## iter  60 value 20.962043
## iter  70 value 20.961666
## final  value 20.961650
## converged
## # weights:  127
## initial  value 120.935110
## iter  10 value 37.437446
## iter  20 value 23.875418
## iter  30 value 21.504472
## iter  40 value 21.082912
## iter  50 value 20.961217
## iter  60 value 20.957893
## iter  70 value 20.957690
## iter  80 value 20.957599
```

```
## final  value 20.957595
## converged
## # weights:  145
## initial  value 127.326271
## iter  10 value 39.119822
## iter  20 value 24.148093
## iter  30 value 21.673345
## iter  40 value 21.214715
## iter  50 value 20.824084
## iter  60 value 20.661743
## iter  70 value 20.573880
## iter  80 value 20.527201
## iter  90 value 20.492865
## iter 100 value 20.479331
## final  value 20.479331
## stopped after 100 iterations
## # weights:  163
## initial  value 117.573192
## iter  10 value 31.747021
## iter  20 value 21.988468
## iter  30 value 20.987766
## iter  40 value 20.782386
## iter  50 value 20.599486
## iter  60 value 20.574000
## iter  70 value 20.551172
## iter  80 value 20.530676
## iter  90 value 20.530421
## iter 100 value 20.530378
## final  value 20.530378
## stopped after 100 iterations
## # weights:  181
## initial  value 121.982675
## iter  10 value 34.771078
## iter  20 value 22.508237
## iter  30 value 20.946221
## iter  40 value 20.453190
## iter  50 value 20.382455
## iter  60 value 20.347663
## iter  70 value 20.322847
## iter  80 value 20.318457
## iter  90 value 20.318229
## iter 100 value 20.318128
## final  value 20.318128
## stopped after 100 iterations
## # weights:  199
## initial  value 128.526310
## iter  10 value 26.224948
## iter  20 value 21.534646
## iter  30 value 20.956784
## iter  40 value 20.674150
## iter  50 value 20.636984
## iter  60 value 20.609709
## iter  70 value 20.551423
## iter  80 value 20.538467
```

```
## iter  90 value 20.535867
## iter 100 value 20.535147
## final  value 20.535147
## stopped after 100 iterations
## # weights:  217
## initial  value 120.185013
## iter  10 value 30.642452
## iter  20 value 23.031010
## iter  30 value 21.407924
## iter  40 value 20.924594
## iter  50 value 20.761514
## iter  60 value 20.453279
## iter  70 value 20.366577
## iter  80 value 20.330269
## iter  90 value 20.325063
## iter 100 value 20.319707
## final  value 20.319707
## stopped after 100 iterations
## # weights:  235
## initial  value 118.302866
## iter  10 value 25.847507
## iter  20 value 21.433944
## iter  30 value 20.723024
## iter  40 value 20.508786
## iter  50 value 20.424411
## iter  60 value 20.414413
## iter  70 value 20.412811
## iter  80 value 20.409461
## iter  90 value 20.334305
## iter 100 value 20.316689
## final  value 20.316689
## stopped after 100 iterations
## # weights:  253
## initial  value 162.393765
## iter  10 value 25.071055
## iter  20 value 21.211326
## iter  30 value 20.598922
## iter  40 value 20.492701
## iter  50 value 20.432802
## iter  60 value 20.407665
## iter  70 value 20.400821
## iter  80 value 20.397840
## iter  90 value 20.396554
## iter 100 value 20.396126
## final  value 20.396126
## stopped after 100 iterations
## # weights:  271
## initial  value 115.822851
## iter  10 value 27.140445
## iter  20 value 21.612118
## iter  30 value 20.956888
## iter  40 value 20.642976
## iter  50 value 20.513822
## iter  60 value 20.471547
```

```
## iter  70 value 20.454357
## iter  80 value 20.446685
## iter  90 value 20.440901
## iter 100 value 20.423216
## final  value 20.423216
## stopped after 100 iterations
## # weights:  289
## initial  value 127.336724
## iter  10 value 25.589490
## iter  20 value 21.354499
## iter  30 value 20.690963
## iter  40 value 20.565476
## iter  50 value 20.386691
## iter  60 value 20.358390
## iter  70 value 20.348939
## iter  80 value 20.347145
## iter  90 value 20.346726
## iter 100 value 20.346614
## final  value 20.346614
## stopped after 100 iterations
## # weights:  307
## initial  value 126.161615
## iter  10 value 39.981950
## iter  20 value 22.523667
## iter  30 value 21.264113
## iter  40 value 20.780350
## iter  50 value 20.569727
## iter  60 value 20.500271
## iter  70 value 20.473230
## iter  80 value 20.468291
## iter  90 value 20.467775
## iter 100 value 20.467653
## final  value 20.467653
## stopped after 100 iterations
## # weights:  325
## initial  value 146.909941
## iter  10 value 25.926785
## iter  20 value 21.693609
## iter  30 value 21.160345
## iter  40 value 20.671442
## iter  50 value 20.419228
## iter  60 value 20.342861
## iter  70 value 20.320287
## iter  80 value 20.313371
## iter  90 value 20.311980
## iter 100 value 20.309016
## final  value 20.309016
## stopped after 100 iterations
## # weights:  37
## initial  value 128.192304
## iter  10 value 41.932050
## iter  20 value 25.880229
## iter  30 value 24.916215
## iter  40 value 24.894577
```

```
## final  value 24.894520
## converged
```

```
modeloPM
```

```
## Neural Network
##
## 185 samples
##  16 predictor
##   2 classes: 'Perdido', 'Ganado'
##
## Pre-processing: centered (16), scaled (16)
## Resampling: Cross-Validated (10 fold)
## Summary of sample sizes: 166, 165, 167, 167, 167, 166, ...
## Resampling results across tuning parameters:
##
##   size  decay  Accuracy   Kappa
##    1    0.00   0.9084503  0.8168987
##    1    0.05   0.9245322  0.8490023
##    1    0.10   0.9078655  0.8156690
##    2    0.00   0.9090058  0.8180110
##    2    0.05   0.9248246  0.8494995
##    2    0.10   0.9250877  0.8502320
##    3    0.00   0.9248246  0.8496175
##    3    0.05   0.9034503  0.8068987
##    3    0.10   0.9195322  0.8390023
##    4    0.00   0.8867836  0.7732115
##    4    0.05   0.8976023  0.7950551
##    4    0.10   0.9084211  0.8167801
##    5    0.00   0.8707018  0.7418052
##    5    0.05   0.9084211  0.8167801
##    5    0.10   0.9084211  0.8167801
##    6    0.00   0.8703801  0.7408375
##    6    0.05   0.8973099  0.7945578
##    6    0.10   0.9139766  0.8278912
##    7    0.00   0.9031287  0.8060469
##    7    0.05   0.9195322  0.8390023
##    7    0.10   0.9087135  0.8172773
##    8    0.00   0.8864912  0.7730681
##    8    0.05   0.9139766  0.8278912
##    8    0.10   0.9139766  0.8278912
##    9    0.00   0.8817836  0.7633314
##    9    0.05   0.9195322  0.8390023
##    9    0.10   0.9195322  0.8390023
##   10    0.00   0.8914912  0.7828329
##   10    0.05   0.9028655  0.8056690
##   10    0.10   0.9195322  0.8390023
##   11    0.00   0.8762281  0.7523382
##   11    0.05   0.9084211  0.8167801
##   11    0.10   0.9139766  0.8278912
##   12    0.00   0.8923099  0.7844425
##   12    0.05   0.8973099  0.7945578
##   12    0.10   0.9139766  0.8278912
##   13    0.00   0.8873392  0.7744399
```

```
##   13    0.05   0.9028655  0.8056690
##   13    0.10   0.8973099  0.7945578
##   14    0.00   0.8768129  0.7535601
##   14    0.05   0.9139766  0.8278912
##   14    0.10   0.9139766  0.8278912
##   15    0.00   0.8812281  0.7619798
##   15    0.05   0.8973099  0.7945578
##   15    0.10   0.9139766  0.8278912
##   16    0.00   0.9031579  0.8063944
##   16    0.05   0.9250877  0.8501134
##   16    0.10   0.9195322  0.8390023
##   17    0.00   0.8540351  0.7077674
##   17    0.05   0.8973099  0.7945578
##   17    0.10   0.9028655  0.8056690
##   18    0.00   0.8870468  0.7741792
##   18    0.05   0.9139766  0.8278912
##   18    0.10   0.9139766  0.8278912
##
## Accuracy was used to select the optimal model using the largest value.
## The final values used for the model were size = 2 and decay = 0.1.
```

```
modeloPM$finalModel
```

```
## a 16-2-1 network with 37 weights
## inputs: `\`Sets jugados\`` BP G `\`Saque-Tot\`` `\`Saque-Pts\`` `\`Saque-Err\`` `\`Recep-Tot\`` `\`R
## output(s): .outcome
## options were - entropy fitting  decay=0.1
```

```
summary(modeloPM)
```

```
## a 16-2-1 network with 37 weights
## options were - entropy fitting  decay=0.1
##   b->h1  i1->h1  i2->h1  i3->h1  i4->h1  i5->h1  i6->h1  i7->h1  i8->h1  i9->h1
##    0.36    0.34    1.98    0.56    1.05    0.03    0.71   -3.05   -0.54   -1.55
## i10->h1 i11->h1 i12->h1 i13->h1 i14->h1 i15->h1 i16->h1
##    0.26   -0.13   -0.75   -1.40    1.87   -0.01   -0.20
##   b->h2  i1->h2  i2->h2  i3->h2  i4->h2  i5->h2  i6->h2  i7->h2  i8->h2  i9->h2
##    0.41    0.34   -1.47   -0.39   -1.21    0.22    0.84    2.73    0.19   -0.93
## i10->h2 i11->h2 i12->h2 i13->h2 i14->h2 i15->h2 i16->h2
##    0.62   -0.73    0.59    0.60   -1.42   -0.15    0.14
##  b->o h1->o h2->o
## -0.59  5.59 -5.26
```

```
# modeloPM$results
```

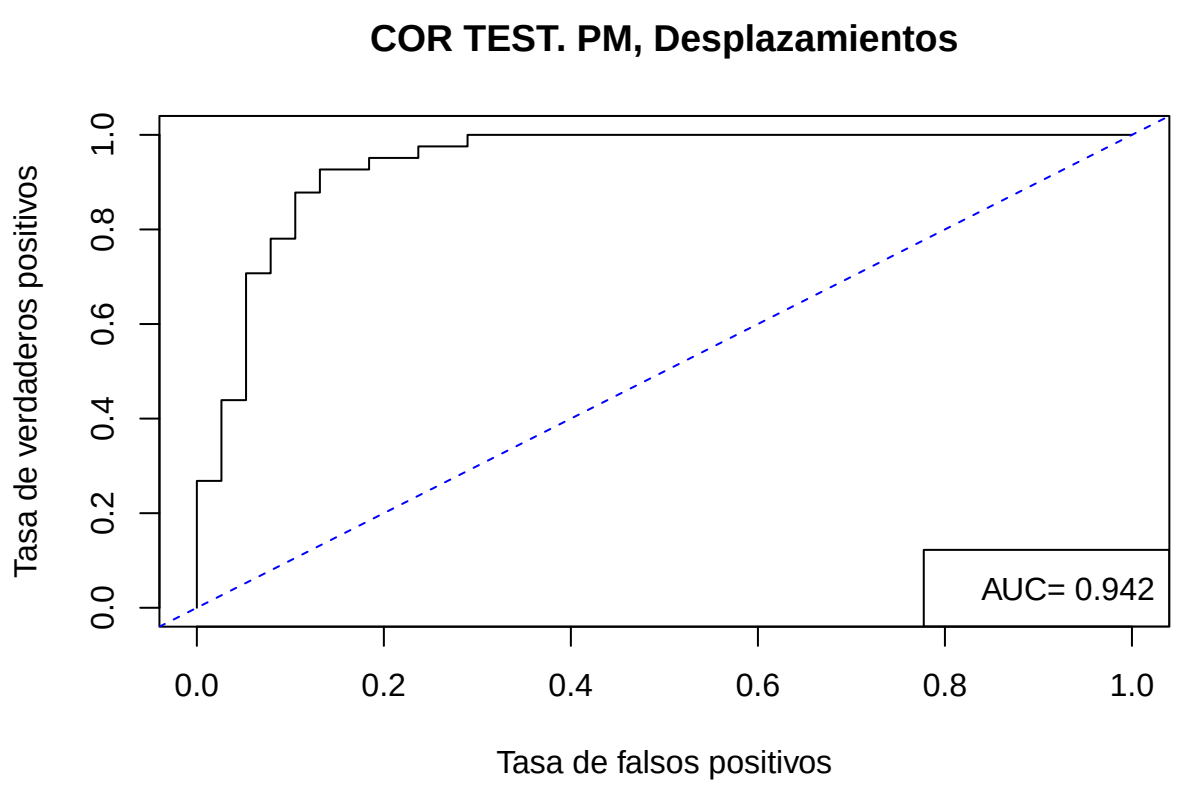
```
preditestPM= predict(modeloPM,dattest[,-18])
confutestPM=table(RealPM_test=dattest[,18]$`Ganado/Perdido`,
                  PredPM_test=preditestPM)
confutestPM
```

```
##            PredPM_test
## RealPM_test Perdido Ganado
##     Perdido      38      3
##     Ganado        5     33
```

```
AciertoPM=round(100*mean(dattest$`Ganado/Perdido`==preditestPM),2)
SensEspecPM=round(100*diag(prop.table(confutestPM,1)),2)
c(AciertoPM, SensEspecPM)
```

```
##         Perdido  Ganado
##   89.87   92.68   86.84
```

```
probabiPM= predict(modeloPM,newdata = dat[inditest,2:17] ,
                   type="prob")[,1] #Prob. ganar
prediobjPM=prediction(probabiPM,dat[inditest,18])
plot(performance(prediobjPM, "tpr","fpr"),
     main="COR TEST. PM, Desplazamientos",
     xlab="Tasa de falsos positivos",
     ylab="Tasa de verdaderos positivos")
abline(a=0,b=1,col="blue",lty=2)
aucPM= as.numeric(performance(prediobjPM,"auc")@y.values)
legend("bottomright",legend=paste("AUC=",round(aucPM,3)))
```




```
Resul=rbind(Resul,c(AciertoPM,aucPM,SensEspecPM))
rownames(Resul)=c("Gauss","Kernel(Poisson)","LDA","R.Logistica","Perceptron Multicapas")
Resul
```

```
##                       Acierto       AUC     0     1
## Gauss                   84.81 0.8940950 85.37 84.21
```

```
## Kernel(Poisson)         81.01 0.9107831 78.05 84.21
## LDA                     88.61 0.9460847 87.80 89.47
## R.Logistica             87.34 0.9403081 90.24 84.21
## Perceptron Multicapas   89.87 0.9415918 92.68 86.84
```

Vectores soporte

Vamos a ver si la muestra está balanceada

```
table(datent$`Ganado/Perdido`) # datos no balanceados
```

```
##
## Perdido  Ganado
##      92      93
```

Vamos a hacerlo con la librería caret.

```
#Definir opciones para train
ctrl <- trainControl(method="cv",classProbs=TRUE,
                     summaryFunction = twoClassSummary)

modeloSVM <- train(`Ganado/Perdido` ~ ., data = datent[,2:18],
                   method = "svmRadial",
                   trControl = ctrl,
                   preProcess = "range",
                   rangeBounds  =c(0,1),
                   tuneGrid = expand.grid(C=c(0.1,1,5,10,50),
                                          sigma=c(0.025,0.035,0.5)) )
```

```
## Warning in train.default(x, y, weights = w, ...): The metric "Accuracy" was not
## in the result set. ROC will be used instead.
```

```
modeloSVM
```

```
## Support Vector Machines with Radial Basis Function Kernel
##
## 185 samples
##  16 predictor
##   2 classes: 'Perdido', 'Ganado'
##
## Pre-processing: re-scaling to [0, 1] (16)
## Resampling: Cross-Validated (10 fold)
## Summary of sample sizes: 166, 167, 167, 165, 166, 167, ...
## Resampling results across tuning parameters:
##
##   C     sigma  ROC        Sens       Spec
##    0.1  0.025  0.9680247  0.8477778  0.9566667
##    0.1  0.035  0.9655556  0.8366667  0.9344444
##    0.1  0.500  0.9380247  0.3111111  0.8522222
##    1.0  0.025  0.9694938  0.8811111  0.9155556
##    1.0  0.035  0.9646790  0.8811111  0.8833333
```

```
##    1.0  0.500  0.9311111  0.9133333  0.8288889
##    5.0  0.025  0.9639259  0.8822222  0.8722222
##    5.0  0.035  0.9555432  0.8600000  0.8722222
##    5.0  0.500  0.9265432  0.8800000  0.8188889
##   10.0  0.025  0.9577654  0.8700000  0.8944444
##   10.0  0.035  0.9413333  0.8688889  0.8944444
##   10.0  0.500  0.9265432  0.8688889  0.8300000
##   50.0  0.025  0.9270123  0.8788889  0.8844444
##   50.0  0.035  0.9328272  0.8566667  0.8833333
##   50.0  0.500  0.9265432  0.8911111  0.8300000
##
## ROC was used to select the optimal model using the largest value.
## The final values used for the model were sigma = 0.025 and C = 1.
```

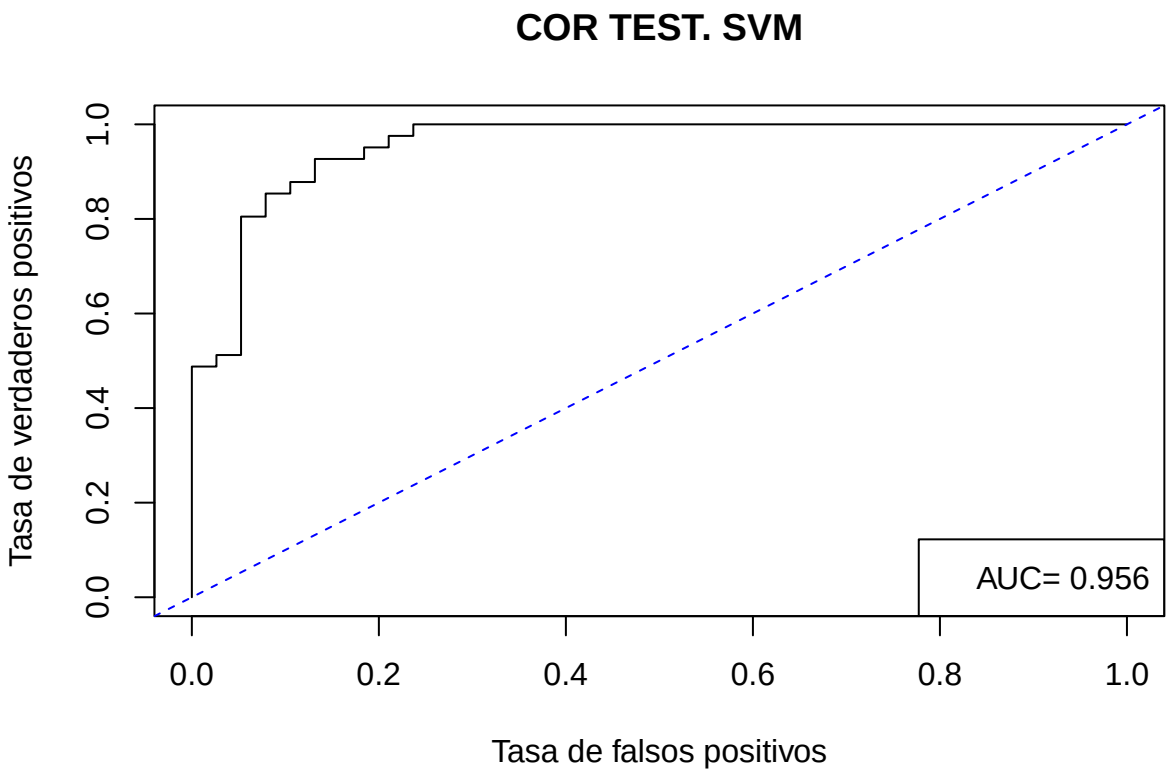
```
predictestSVM<- predict(modeloSVM,dattest[,2:17])
confutestSVM<-table(Real=dattest$`Ganado/Perdido`,
                Pred=predictestSVM)
confutestSVM
```

```
##          Pred
## Real      Perdido Ganado
##   Perdido      38      3
##   Ganado        7     31
```

```
AciertoSVM=round(100*mean(dattest$`Ganado/Perdido`==predictestSVM),2)
SensEspecSVM=round(100*diag(prop.table(confutestSVM,1)),2)
c(AciertoSVM, SensEspecSVM)
```

```
##         Perdido  Ganado
##   87.34   92.68   81.58
```

```
probabiSVM= predict(modeloSVM,newdata = dat[inditest,2:17] ,
                  type="prob")[,1] #Prob. ganar
prediobjSVM=prediction(probabiSVM,dat[inditest,18])
plot(performance(prediobjSVM, "tpr","fpr"),
     main="COR TEST. SVM",
     xlab="Tasa de falsos positivos",
     ylab="Tasa de verdaderos positivos")
abline(a=0,b=1,col="blue",lty=2)
aucSVM= as.numeric(performance(prediobjSVM,"auc")@y.values)
legend("bottomright",legend=paste("AUC=",round(aucSVM,3)))
```




```
Resul=rbind(Resul,c(AciertoSVM,aucSVM,SensEspecSVM))
rownames(Resul)=c("Gauss","Kernel(Poisson)","LDA","R.Logistica","Perceptron Multicapas", "Vectores sopo
Resul
```

```
##                         Acierto       AUC     0     1
## Gauss                     84.81 0.8940950 85.37 84.21
## Kernel(Poisson)           81.01 0.9107831 78.05 84.21
## LDA                       88.61 0.9460847 87.80 89.47
## R.Logistica               87.34 0.9403081 90.24 84.21
## Perceptron Multicapas     89.87 0.9415918 92.68 86.84
## Vectores soporte          87.34 0.9557125 92.68 81.58
```

Vamos a utilizar la técnica UPSAMPLE: se muestrea con reemplazamiento en la clase minoritaria para igualar el número de casos de la clase mayoritaria. Comparamos los dos modelos puesto que las muestras no son balanceadas por un registro.

```
upSampled_train = upSample(datent[, 2:17],
                           datent$`Ganado/Perdido`)
dim(upSampled_train)
```

```
## [1] 186  17
```

```
table(upSampled_train$Class)
```

```
##
## Perdido  Ganado
##      93      93
```

```
names(upSampled_train)[17]= "Ganado/Perdido"
```

```
ctrl5 = trainControl(method = "cv",
                     number=5,
                    classProbs = TRUE,
                    summaryFunction = twoClassSummary)

SVMUp=train(`Ganado/Perdido` ~ .,
            data = upSampled_train,
            method = "svmRadial",
            preProcess = "range",
            rangeBounds =c(0,1),
            tuneLength=10,
            trControl = ctrl5,
            tuneGrid = expand.grid(C=c(0.1,1,5,10,50),
                                   sigma=c(0.025,0.035,0.05)),
            metric="Sens")
SVMUp
```

```
## Support Vector Machines with Radial Basis Function Kernel
##
## 186 samples
##  16 predictor
##   2 classes: 'Perdido', 'Ganado'
##
## Pre-processing: re-scaling to [0, 1] (16)
## Resampling: Cross-Validated (5 fold)
## Summary of sample sizes: 148, 148, 148, 150, 150
## Resampling results across tuning parameters:
##
##   C     sigma  ROC        Sens       Spec
##    0.1  0.025  0.9653039  0.8280702  0.9251462
##    0.1  0.035  0.9717144  0.8280702  0.9245614
##    0.1  0.050  0.9668394  0.8280702  0.9035088
##    1.0  0.025  0.9714613  0.8812865  0.9029240
##    1.0  0.035  0.9696095  0.8596491  0.9029240
##    1.0  0.050  0.9702267  0.8608187  0.9029240
##    5.0  0.025  0.9729336  0.9040936  0.8912281
##    5.0  0.035  0.9712082  0.8929825  0.8912281
##    5.0  0.050  0.9663332  0.8929825  0.8807018
##   10.0  0.025  0.9741681  0.8929825  0.8912281
##   10.0  0.035  0.9676311  0.9040936  0.8801170
##   10.0  0.050  0.9580709  0.8608187  0.8590643
##   50.0  0.025  0.9590045  0.8508772  0.8807018
##   50.0  0.035  0.9508054  0.8502924  0.8807018
##   50.0  0.050  0.9426063  0.8608187  0.8590643
##
## Sens was used to select the optimal model using the largest value.
## The final values used for the model were sigma = 0.025 and C = 5.
```

Evaluamos el modelo

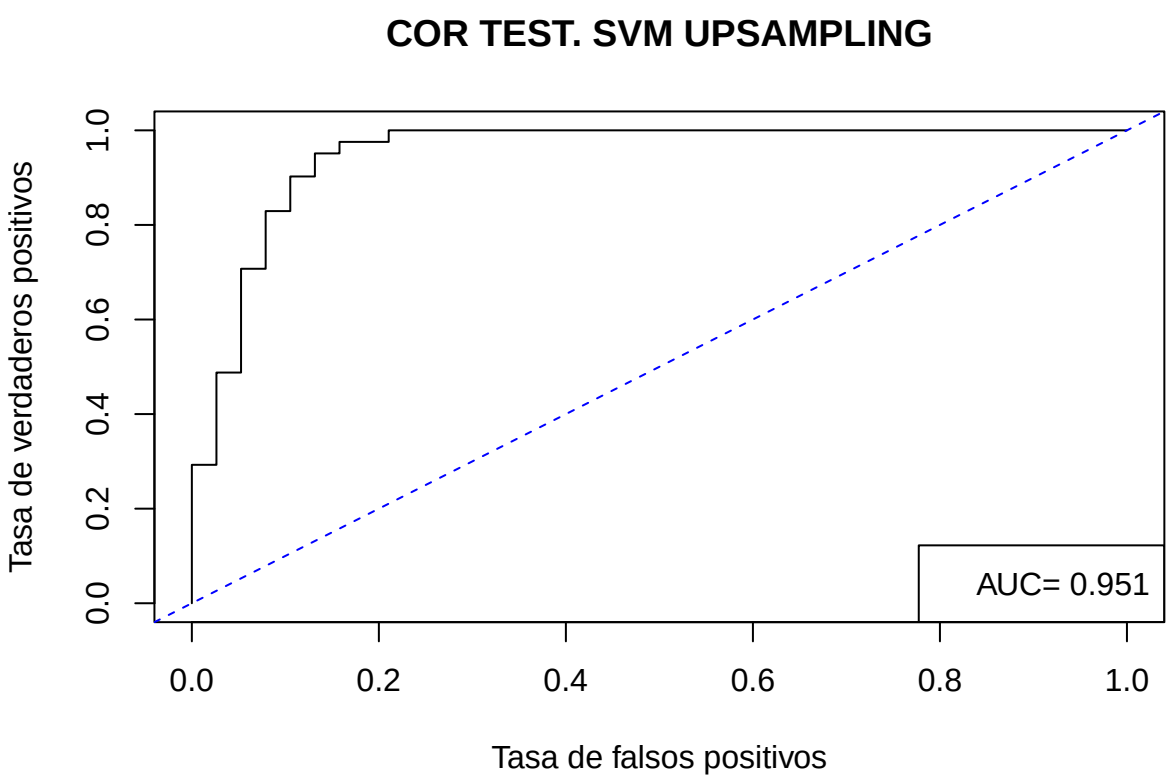
```
predictestUp = predict(SVMUp, dattest[,2:17])

confutestSVM_up<-table(Real=dattest$`Ganado/Perdido`,
                Pred=predictestUp)
confutestSVM_up
```

```
##          Pred
## Real      Perdido Ganado
##   Perdido      37      4
##   Ganado        4     34
```

```
AciertoSVM_up=round(100*mean(dattest$`Ganado/Perdido`==predictestUp),2)
SensEspecSVM_up=round(100*diag(prop.table(confutestSVM_up,1)),2)
c(AciertoSVM_up, SensEspecSVM_up)
```

```
##         Perdido  Ganado
##   89.87   90.24   89.47
```

```
probabiSVM_up= predict(SVMUp,newdata = dat[inditest,2:17] ,
                  type="prob")[,1] #Prob. ganar
prediobjSVM_up = prediction(probabiSVM_up,dat[inditest,18])
plot(performance(prediobjSVM_up, "tpr","fpr"),
     main="COR TEST. SVM UPSAMPLING",
     xlab="Tasa de falsos positivos",
     ylab="Tasa de verdaderos positivos")
abline(a=0,b=1,col="blue",lty=2)
aucSVM_up = as.numeric(performance(prediobjSVM_up,"auc")@y.values)
legend("bottomright",legend=paste("AUC=",round(aucSVM_up,3)))
```




```
Resul=rbind(Resul,c(AciertoSVM_up,aucSVM_up,SensEspecSVM_up))
rownames(Resul)=c("Gauss","Kernel(Poisson)","LDA","R.Logistica","Perceptron Multicapas", "Vectores sopo
Resul
```

```
##                                Acierto       AUC     0     1
## Gauss                            84.81 0.8940950 85.37 84.21
## Kernel(Poisson)                  81.01 0.9107831 78.05 84.21
## LDA                              88.61 0.9460847 87.80 89.47
## R.Logistica                      87.34 0.9403081 90.24 84.21
## Perceptron Multicapas            89.87 0.9415918 92.68 86.84
## Vectores soporte                 87.34 0.9557125 92.68 81.58
## Vectores soporte con Upsampling  89.87 0.9505777 90.24 89.47
```

Árbol de clasificación

```
library(rpart)
library(graphics)
modeloAB <- rpart(`Ganado/Perdido` ~ .,
                  data=datent[,2:18],method="class")
modeloAB
```

```
## n= 185
##
```

```
## node), split, n, loss, yval, (yprob)
##       * denotes terminal node
##
##  1) root 185 92 Ganado (0.49729730 0.50270270)
##    2) BP< 22.5 70  6 Perdido (0.91428571 0.08571429) *
##    3) BP>=22.5 115 28 Ganado (0.24347826 0.75652174)
##      6) Recep-Tot>=80.5 51 25 Perdido (0.50980392 0.49019608)
##       12) Ataque-Exc< 58.5 22  4 Perdido (0.81818182 0.18181818) *
##       13) Ataque-Exc>=58.5 29  8 Ganado (0.27586207 0.72413793) *
##      7) Recep-Tot< 80.5 64  2 Ganado (0.03125000 0.96875000) *
```

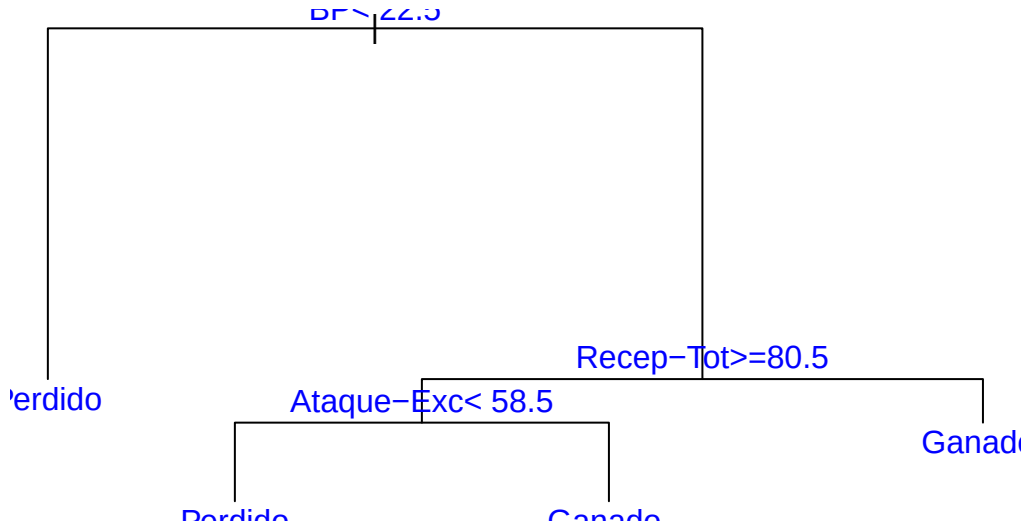
```
# summary(modeloAB)
modeloAB$parms #probabilidades a priori, costes
```

```
## $prior
##         1         2
## 0.4972973 0.5027027
##
## $loss
##      [,1] [,2]
## [1,]    0    1
## [2,]    1    0
##
## $split
## [1] 1
```

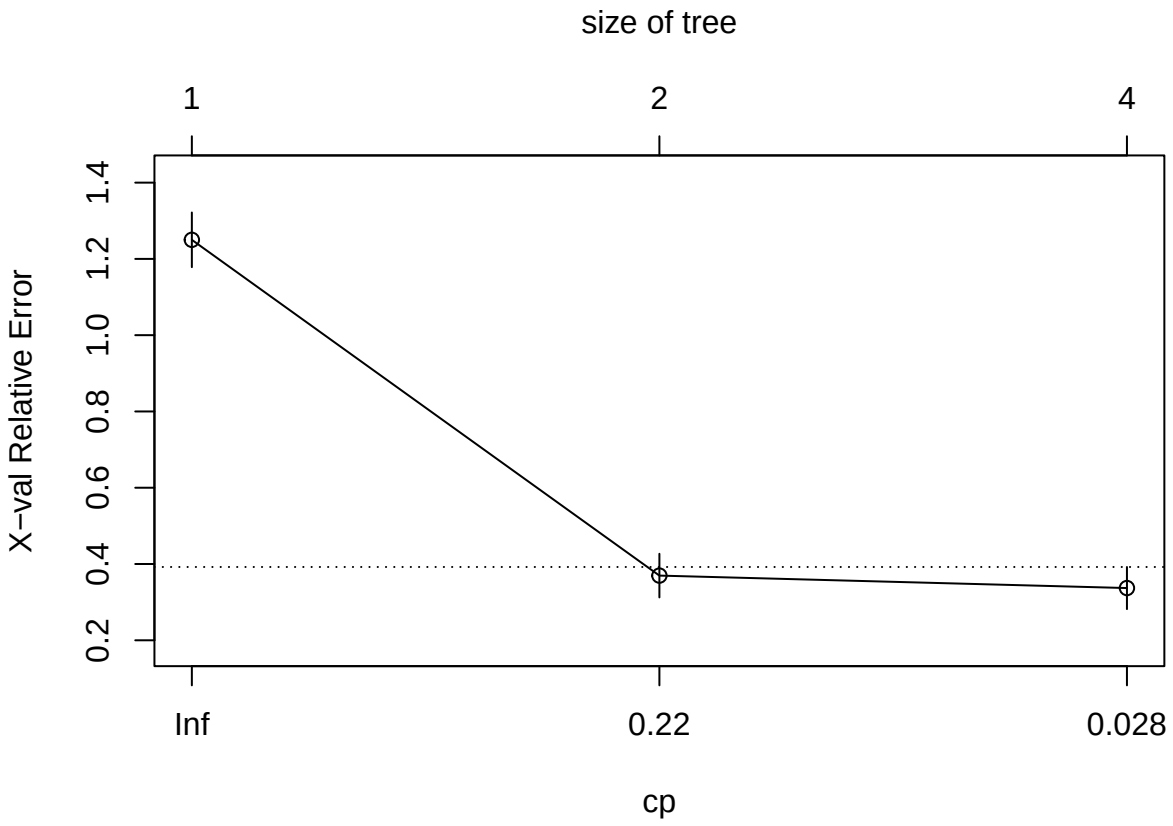
```
modeloAB$variable.importance
```

```
##           BP    Saque-Tot   Ataque-Exc            G    Saque-Pts    Recep-Tot
##    39.160651    33.574644    24.701109    19.053283    16.783136    13.000021
##   Ataque-Tot  Bloqueo-Pts Sets jugados    Recep-Exc
##    12.266372    11.517317    10.339075     7.392169
```

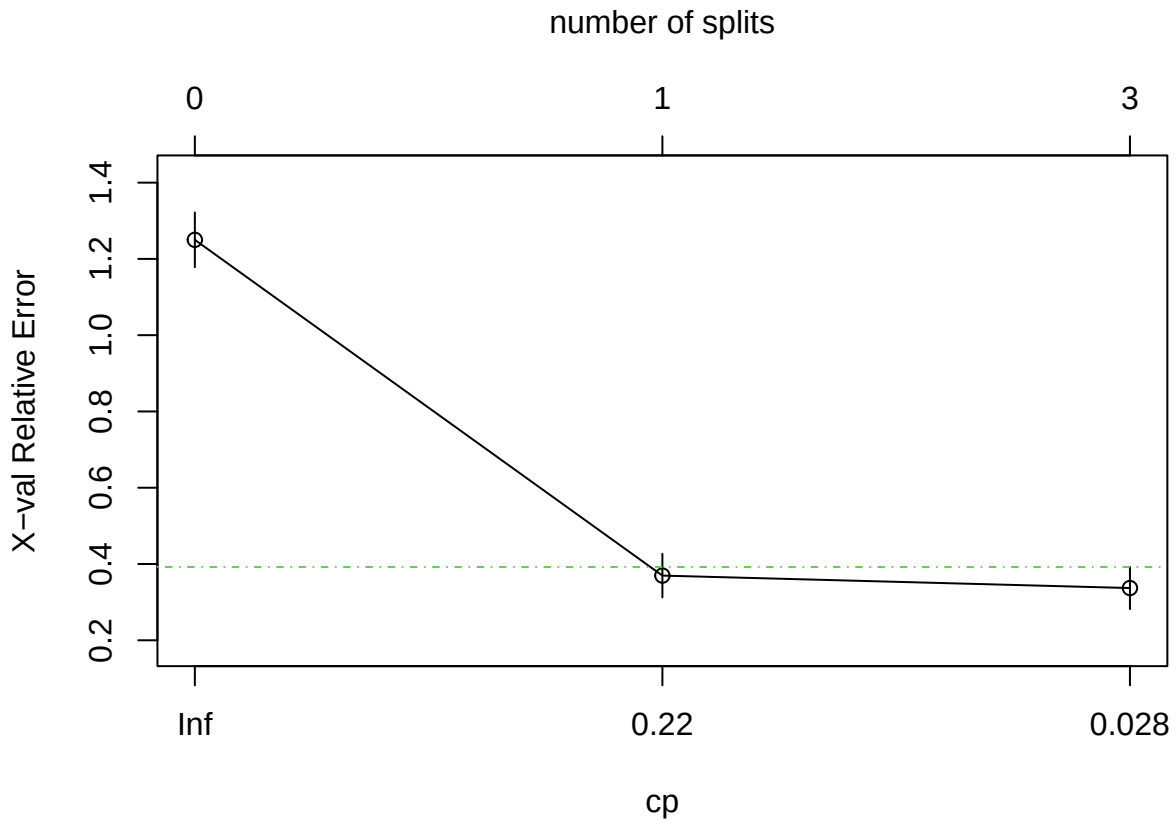
```
plot(modeloAB,main="Arbol de clasificacion",compress=TRUE)
text(modeloAB,col="blue")
```




```
plotcp(modeloAB) # tamaños
```




```
plotcp(modeloAB,upper = c("splits"),lty = 10,col=3) # numero de divisiones
```




```
printcp(modeloAB)
```

```
##
## Classification tree:
## rpart(formula = `Ganado/Perdido` ~ ., data = datent[, 2:18],
##     method = "class")
##
## Variables actually used in tree construction:
## [1] Ataque-Exc BP         Recep-Tot
##
## Root node error: 92/185 = 0.4973
##
## n= 185
##
##         CP nsplit rel error  xerror     xstd
## 1 0.630435      0   1.00000 1.25000 0.071701
## 2 0.076087      1   0.36957 0.36957 0.057260
## 3 0.010000      3   0.21739 0.33696 0.055216
```

```
predictestAB <- predict(modeloAB,type="class", dattest[,2:17])
confutestAB<-table(dattest$`Ganado/Perdido`,predictestAB,deparse.level = 2)
confutestAB
```

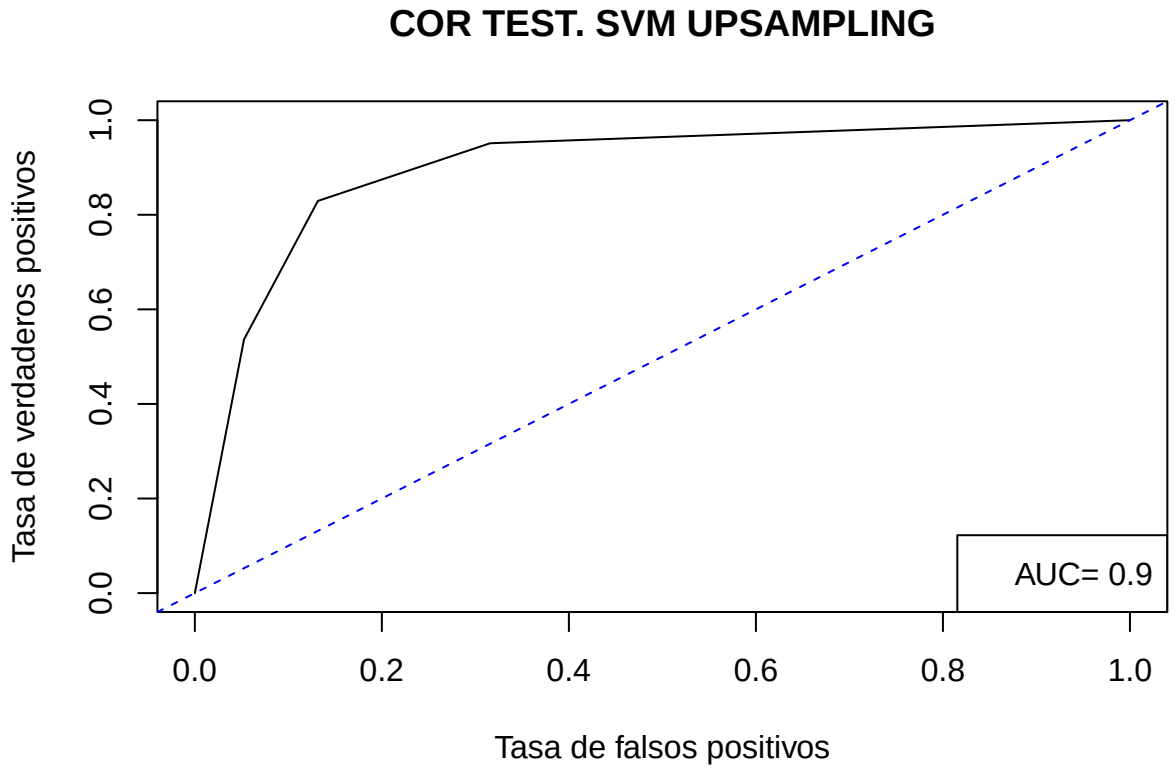
```
##                          predictestAB
## dattest$`Ganado/Perdido` Perdido Ganado
```

```
##                  Perdido      34       7
##                  Ganado        5      33
```

```
AciertoAB=round(100*mean(dattest$`Ganado/Perdido`==predictestAB),2)
SensEspecAB=round(100*diag(prop.table(confutestAB,1)),2)
c(AciertoAB, SensEspecAB)
```

```
##         Perdido  Ganado
##   84.81   82.93   86.84
```

```
probabiAB= predict(modeloAB,newdata = dat[inditest,2:17] ,
                   type="prob")[,1]
prediobjAB = prediction(probabiAB,dat[inditest,18])
plot(performance(prediobjAB, "tpr","fpr"),
     main="COR TEST. SVM UPSAMPLING",
     xlab="Tasa de falsos positivos",
     ylab="Tasa de verdaderos positivos")
abline(a=0,b=1,col="blue",lty=2)
aucAB = as.numeric(performance(prediobjAB,"auc")@y.values)
legend("bottomright",legend=paste("AUC=",round(aucAB,3)))
```



Conclusiones

```
Resul=rbind(Resul,c(AciertoAB,aucAB,SensEspecAB))
rownames(Resul)=c("Gauss","Kernel(Poisson)","LDA","R.Logistica","Perceptron Multicapas", "Vectores sopo
Resul
```

```
##                                 Acierto       AUC     0     1
## Gauss                             84.81 0.8940950 85.37 84.21
## Kernel(Poisson)                   81.01 0.9107831 78.05 84.21
## LDA                               88.61 0.9460847 87.80 89.47
## R.Logistica                       87.34 0.9403081 90.24 84.21
## Perceptron Multicapas             89.87 0.9415918 92.68 86.84
## Vectores soporte                  87.34 0.9557125 92.68 81.58
## Vectores soporte con Upsampling   89.87 0.9505777 90.24 89.47
## Arbol de clasificacion            84.81 0.8995507 82.93 86.84
```

```
library(pROC)
```

```
## Type 'citation("pROC")' for a citation.

##
## Attaching package: 'pROC'

## The following objects are masked from 'package:stats':
##
##     cov, smooth, var
```

```
ROCtestNB1 = roc(dattest$`Ganado/Perdido`, probabi1)
```

```
## Setting levels: control = Perdido, case = Ganado

## Setting direction: controls < cases
```

```
ROCtestNB2 = roc(dattest$`Ganado/Perdido`, probabi2)
```

```
## Setting levels: control = Perdido, case = Ganado
## Setting direction: controls < cases
```

```
ROCtestLDA = roc(dattest$`Ganado/Perdido`, probabiLDA)
```

```
## Setting levels: control = Perdido, case = Ganado
## Setting direction: controls < cases
```

```
ROCtestPM = roc(dattest$`Ganado/Perdido`, probabiPM)
```

```
## Setting levels: control = Perdido, case = Ganado

## Setting direction: controls > cases
```

```
ROCtestSVM = roc(dattest$`Ganado/Perdido`, probabiSVM)
```

```
## Setting levels: control = Perdido, case = Ganado
## Setting direction: controls > cases
```

```
ROCtestUp = roc(dattest$`Ganado/Perdido`, probabiSVM_up)
```

```
## Setting levels: control = Perdido, case = Ganado
## Setting direction: controls > cases
```

```
ROCtestAB = roc(dattest$`Ganado/Perdido`, probabiAB)
```

```
## Setting levels: control = Perdido, case = Ganado
## Setting direction: controls > cases
```

```
plot(ROCtestNB1,col=1,lwd=2,main="ROC modelos")
lines(ROCtestNB2,col=2,lwd=2)
lines(ROCtestLDA,col=3,lwd=2)
lines(ROCtestPM,col=4,lwd=2)
lines(ROCtestSVM,col=5,lwd=2)
lines(ROCtestUp,col=6,lwd=2)
lines(ROCtestAB,col=7,lwd=2)
legend(x = "bottomright", legend = c("N.Bayes 1", "N.Bayes 2", "A. Discrim. Lineal", "Perceptron multica
```