Cronin ADM Assignment 3

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2023-04-28

```
library(ISLR)
## Warning: package 'ISLR' was built under R version 4.0.3
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

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

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

```
## Warning: package 'dplyr' was built under R version 4.0.2
## Warning: replacing previous import 'vctrs::data_frame' by 'tibble::data_frame'
## when loading 'dplyr'
##
## Attaching package: 'dplyr'
## The following objects are masked from 'package:stats':
##
## filter, lag
## The following objects are masked from 'package:base':
##
## intersect, setdiff, setequal, union
library(glmnet)
```

```
## Loading required package: Matrix
```

```
## Loaded glmnet 4.1-7
```

```
## Warning: package 'glmnet' was built under R version 4.0.2
## Loading required package: Matrix
## Loaded glmnet 4.0-2
library(caret)
```

```
## Loading required package: ggplot2
```

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

```
## Warning: package 'caret' was built under R version 4.0.3
## Loading required package: lattice
## Loading required package: ggplot2
## Warning: package 'ggplot2' was built under R version 4.0.2
library(kernlab)
```

```
##
## Attaching package: 'kernlab'
```

```
## The following object is masked from 'package:ggplot2':
##
##      alpha
```

```
library(rpart)
library(rpart.plot)
library(rsample)
library(neuralnet)
```

```
##
## Attaching package: 'neuralnet'
```

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

```
Carseats_Filtered <- Carseats %>% select("Sales", "Price",
"Advertising","Population","Age","Income","Education")
```

```
trctrl <- trainControl(method = "repeatedcv", number = 10, repeats = 3)
set.seed(2018)
svm_Linear <- train(Sales ~., data = Carseats_Filtered, method = "svmLinear",
trControl=trctrl,
preProcess = c("center", "scale"),
tuneLength = 10)
```

```
svm_Linear
```

```
## Support Vector Machines with Linear Kernel
##
## 400 samples
##   6 predictor
##
## Pre-processing: centered (6), scaled (6)
## Resampling: Cross-Validated (10 fold, repeated 3 times)
## Summary of sample sizes: 360, 360, 360, 360, 360, 360, ...
## Resampling results:
##
##   RMSE       Rsquared    MAE
##   2.256291   0.3674754   1.81232
##
## Tuning parameter 'C' was held constant at a value of 1
```

```
grid <- expand.grid(C = c(0.1,0.5,1,10))
```

```
trctrl <- trainControl(method = "repeatedcv", number = 5, repeats = 2)
set.seed(2018)
svm_Linear2 <- train(Sales ~., data = Carseats_Filtered, method = "svmLinear",
trControl=trctrl,
preProcess = c("center", "scale"),
tuneGrid = grid,
tuneLength = 10)
```

```
svm_Linear2
```

```
## Support Vector Machines with Linear Kernel
##
## 400 samples
##   6 predictor
##
## Pre-processing: centered (6), scaled (6)
## Resampling: Cross-Validated (5 fold, repeated 2 times)
## Summary of sample sizes: 319, 321, 320, 320, 320, 321, ...
## Resampling results across tuning parameters:
##
##   C      RMSE       Rsquared    MAE
##    0.1   2.290577   0.3539543   1.842292
##    0.5   2.292505   0.3533746   1.842250
##    1.0   2.292702   0.3535648   1.842410
##   10.0   2.293013   0.3532265   1.842196
##
## RMSE was used to select the optimal model using the smallest value.
## The final value used for the model was C = 0.1.
```

```
Scale_Model = preProcess(Carseats_Filtered,method = c("range"))
Carseats_Scaled=predict(Scale_Model,Carseats_Filtered)
summary(Carseats_Scaled)
```

```
##      Sales            Price          Advertising        Population
##  Min.   :0.0000   Min.   :0.0000   Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.3313   1st Qu.:0.4551   1st Qu.:0.0000   1st Qu.:0.2585
##  Median :0.4604   Median :0.5569   Median :0.1724   Median :0.5251
##  Mean   :0.4607   Mean   :0.5497   Mean   :0.2288   Mean   :0.5107
##  3rd Qu.:0.5728   3rd Qu.:0.6407   3rd Qu.:0.4138   3rd Qu.:0.7786
##  Max.   :1.0000   Max.   :1.0000   Max.   :1.0000   Max.   :1.0000
##       Age             Income         Education
##  Min.   :0.0000   Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.2682   1st Qu.:0.2197   1st Qu.:0.2500
##  Median :0.5364   Median :0.4848   Median :0.5000
##  Mean   :0.5150   Mean   :0.4814   Mean   :0.4875
##  3rd Qu.:0.7455   3rd Qu.:0.7071   3rd Qu.:0.7500
##  Max.   :1.0000   Max.   :1.0000   Max.   :1.0000
```

```
set.seed(2018)
numFolds <- trainControl(method = 'cv', number = 10, verboseIter = FALSE) # 10 fold CV
fit <- train(Sales ~ Price + Advertising + Population + Age + Income + Education, data =
Carseats_Scaled,
method = 'nnet', trControl = numFolds)
```

```
## # weights:  9
## initial  value 12.214870
## iter  10 value 9.985836
## iter  20 value 6.700725
## iter  30 value 6.651218
## iter  40 value 6.649182
## iter  50 value 6.638847
## iter  60 value 6.636433
## final   value 6.636283
## converged
## # weights:  25
## initial  value 10.947235
## iter  10 value 6.937870
## iter  20 value 6.552606
## iter  30 value 6.362320
## iter  40 value 6.328796
## iter  50 value 6.314588
## iter  60 value 6.290489
## iter  70 value 6.159567
## iter  80 value 6.122330
## iter  90 value 6.112344
## iter 100 value 6.087740
## final   value 6.087740
## stopped after 100 iterations
## # weights:  41
## initial  value 31.525004
## iter  10 value 7.106148
## iter  20 value 6.610718
## iter  30 value 6.453326
## iter  40 value 6.249549
## iter  50 value 6.023731
## iter  60 value 5.912392
## iter  70 value 5.864858
## iter  80 value 5.846145
## iter  90 value 5.828492
## iter 100 value 5.813400
## final   value 5.813400
## stopped after 100 iterations
## # weights:  9
## initial  value 16.545687
## iter  10 value 10.424065
## iter  20 value 8.988958
## final   value 8.986873
## converged
## # weights:  25
## initial  value 11.410851
## iter  10 value 8.896090
## iter  20 value 8.751440
## iter  30 value 8.748699
## iter  40 value 8.744949
## iter  50 value 8.744614
## final   value 8.744613
```

```
## converged
## # weights:  41
## initial  value 37.822903
## iter  10 value 8.788537
## iter  20 value 8.718672
## iter  30 value 8.714007
## iter  40 value 8.709873
## iter  50 value 8.707441
## iter  60 value 8.702741
## iter  70 value 8.700968
## iter  80 value 8.700959
## final   value 8.700959
## converged
## # weights:   9
## initial  value 12.551898
## iter  10 value 8.257636
## iter  20 value 6.655584
## iter  30 value 6.649651
## iter  40 value 6.642744
## iter  50 value 6.641909
## iter  60 value 6.641898
## iter  60 value 6.641898
## iter  60 value 6.641898
## final   value 6.641898
## converged
## # weights:  25
## initial  value 11.950705
## iter  10 value 8.044890
## iter  20 value 6.654884
## iter  30 value 6.602083
## iter  40 value 6.391735
## iter  50 value 6.209280
## iter  60 value 6.157370
## iter  70 value 6.135179
## iter  80 value 6.121177
## iter  90 value 6.107582
## iter 100 value 6.102980
## final   value 6.102980
## stopped after 100 iterations
## # weights:  41
## initial  value 24.105516
## iter  10 value 7.064933
## iter  20 value 6.463382
## iter  30 value 6.184200
## iter  40 value 6.033489
## iter  50 value 5.992787
## iter  60 value 5.960333
## iter  70 value 5.936825
## iter  80 value 5.919838
## iter  90 value 5.916819
## iter 100 value 5.909453
## final   value 5.909453
```

```
## stopped after 100 iterations
## # weights:  9
## initial  value 12.926402
## iter  10 value 6.957112
## iter  20 value 6.503356
## iter  30 value 6.493767
## iter  40 value 6.469077
## final  value 6.468949
## converged
## # weights:  25
## initial  value 24.157663
## iter  10 value 6.785127
## iter  20 value 6.499409
## iter  30 value 6.481174
## iter  40 value 6.435970
## iter  50 value 6.410838
## iter  60 value 6.391793
## iter  70 value 6.294186
## iter  80 value 6.226387
## iter  90 value 6.179174
## iter 100 value 6.151597
## final  value 6.151597
## stopped after 100 iterations
## # weights:  41
## initial  value 34.471341
## iter  10 value 6.652943
## iter  20 value 6.488926
## iter  30 value 6.373053
## iter  40 value 6.328583
## iter  50 value 6.289058
## iter  60 value 6.199446
## iter  70 value 6.037559
## iter  80 value 5.958229
## iter  90 value 5.930912
## iter 100 value 5.837275
## final  value 5.837275
## stopped after 100 iterations
## # weights:  9
## initial  value 10.655842
## iter  10 value 8.904438
## iter  20 value 8.691361
## final  value 8.691355
## converged
## # weights:  25
## initial  value 21.366378
## iter  10 value 8.725731
## iter  20 value 8.506102
## iter  30 value 8.489220
## iter  40 value 8.488278
## iter  50 value 8.484537
## iter  60 value 8.484026
## iter  70 value 8.483680
```

```
## final   value 8.483680
## converged
## # weights:  41
## initial   value 11.947265
## iter  10 value 8.532458
## iter  20 value 8.468060
## iter  30 value 8.456571
## iter  40 value 8.451729
## iter  50 value 8.451373
## iter  60 value 8.451290
## iter  60 value 8.451290
## iter  60 value 8.451290
## final   value 8.451290
## converged
## # weights:   9
## initial   value 11.855977
## iter  10 value 10.285649
## iter  20 value 6.774876
## iter  30 value 6.523994
## iter  40 value 6.507979
## iter  50 value 6.479785
## iter  60 value 6.479083
## final   value 6.478540
## converged
## # weights:  25
## initial   value 11.233769
## iter  10 value 7.342556
## iter  20 value 6.513835
## iter  30 value 6.406984
## iter  40 value 6.343170
## iter  50 value 6.332158
## iter  60 value 6.262691
## iter  70 value 6.166823
## iter  80 value 6.121550
## iter  90 value 6.103900
## iter 100 value 6.079348
## final   value 6.079348
## stopped after 100 iterations
## # weights:  41
## initial   value 16.123959
## iter  10 value 6.559806
## iter  20 value 6.488100
## iter  30 value 6.429006
## iter  40 value 6.266907
## iter  50 value 6.144641
## iter  60 value 6.049203
## iter  70 value 5.991191
## iter  80 value 5.945182
## iter  90 value 5.924520
## iter 100 value 5.901045
## final   value 5.901045
## stopped after 100 iterations
```

```
## # weights:  9
## initial  value 12.145069
## iter  10 value 10.369276
## iter  20 value 6.794947
## iter  30 value 6.738419
## iter  40 value 6.699624
## iter  50 value 6.699405
## iter  60 value 6.694622
## iter  70 value 6.692294
## iter  80 value 6.684024
## iter  90 value 6.677890
## iter 100 value 6.663684
## final  value 6.663684
## stopped after 100 iterations
## # weights:  25
## initial  value 11.391454
## iter  10 value 6.762607
## iter  20 value 6.567765
## iter  30 value 6.452963
## iter  40 value 6.425513
## iter  50 value 6.350191
## iter  60 value 6.268829
## iter  70 value 6.227898
## iter  80 value 6.176506
## iter  90 value 6.165011
## iter 100 value 6.153251
## final  value 6.153251
## stopped after 100 iterations
## # weights:  41
## initial  value 29.299123
## iter  10 value 6.877254
## iter  20 value 6.688699
## iter  30 value 6.572152
## iter  40 value 6.508390
## iter  50 value 6.393935
## iter  60 value 6.176189
## iter  70 value 5.992789
## iter  80 value 5.932768
## iter  90 value 5.905032
## iter 100 value 5.837411
## final  value 5.837411
## stopped after 100 iterations
## # weights:  9
## initial  value 15.658397
## iter  10 value 9.375787
## iter  20 value 8.982766
## final  value 8.981939
## converged
## # weights:  25
## initial  value 11.246168
## iter  10 value 8.849941
## iter  20 value 8.775749
```

```
## iter  30 value 8.774203
## iter  40 value 8.774024
## iter  50 value 8.765020
## iter  60 value 8.755369
## iter  70 value 8.754941
## final   value 8.754941
## converged
## # weights:  41
## initial  value 11.666025
## iter  10 value 8.878875
## iter  20 value 8.755194
## iter  30 value 8.743846
## iter  40 value 8.733620
## iter  50 value 8.733235
## iter  60 value 8.733162
## iter  70 value 8.733147
## final   value 8.733142
## converged
## # weights:   9
## initial  value 11.397948
## iter  10 value 6.694221
## iter  20 value 6.677891
## iter  30 value 6.673832
## final   value 6.670457
## converged
## # weights:  25
## initial  value 26.609824
## iter  10 value 6.784435
## iter  20 value 6.668133
## iter  30 value 6.628161
## iter  40 value 6.406501
## iter  50 value 6.323596
## iter  60 value 6.290012
## iter  70 value 6.248074
## iter  80 value 6.209527
## iter  90 value 6.204761
## iter 100 value 6.202591
## final   value 6.202591
## stopped after 100 iterations
## # weights:  41
## initial  value 10.791550
## iter  10 value 6.693893
## iter  20 value 6.538177
## iter  30 value 6.336581
## iter  40 value 6.245612
## iter  50 value 6.184901
## iter  60 value 6.135387
## iter  70 value 6.090226
## iter  80 value 6.071928
## iter  90 value 6.069367
## iter 100 value 6.064933
## final   value 6.064933
```

```
## stopped after 100 iterations
## # weights:  9
## initial  value 17.213127
## iter  10 value 7.203789
## iter  20 value 6.509919
## iter  30 value 6.508829
## iter  40 value 6.498563
## final  value 6.498277
## converged
## # weights:  25
## initial  value 14.277738
## iter  10 value 7.081420
## iter  20 value 6.486080
## iter  30 value 6.338677
## iter  40 value 6.302898
## iter  50 value 6.275085
## iter  60 value 6.267443
## iter  70 value 6.248979
## iter  80 value 6.237805
## iter  90 value 6.232267
## iter 100 value 6.228521
## final  value 6.228521
## stopped after 100 iterations
## # weights:  41
## initial  value 22.881496
## iter  10 value 6.998595
## iter  20 value 6.480271
## iter  30 value 6.278546
## iter  40 value 6.220005
## iter  50 value 6.171210
## iter  60 value 6.096642
## iter  70 value 6.059020
## iter  80 value 5.979172
## iter  90 value 5.921355
## iter 100 value 5.823623
## final  value 5.823623
## stopped after 100 iterations
## # weights:  9
## initial  value 17.936332
## iter  10 value 10.210366
## iter  20 value 8.744992
## final  value 8.742104
## converged
## # weights:  25
## initial  value 33.012539
## iter  10 value 9.657121
## iter  20 value 8.548055
## iter  30 value 8.524787
## iter  40 value 8.519457
## iter  50 value 8.519276
## final  value 8.519263
## converged
```

```
## # weights:  41
## initial  value 11.422302
## iter  10 value 8.549885
## iter  20 value 8.512497
## iter  30 value 8.502827
## iter  40 value 8.499969
## iter  50 value 8.498329
## iter  60 value 8.497639
## iter  70 value 8.497415
## final  value 8.497414
## converged
## # weights:  9
## initial  value 16.753490
## iter  10 value 6.951192
## iter  20 value 6.516288
## iter  30 value 6.509827
## final  value 6.504851
## converged
## # weights:  25
## initial  value 15.151862
## iter  10 value 6.759639
## iter  20 value 6.536266
## iter  30 value 6.474973
## iter  40 value 6.326827
## iter  50 value 6.250693
## iter  60 value 6.232654
## iter  70 value 6.220845
## iter  80 value 6.214168
## iter  90 value 6.210600
## iter 100 value 6.205998
## final  value 6.205998
## stopped after 100 iterations
## # weights:  41
## initial  value 11.601581
## iter  10 value 6.562212
## iter  20 value 6.501775
## iter  30 value 6.329972
## iter  40 value 6.123774
## iter  50 value 6.061902
## iter  60 value 6.025081
## iter  70 value 6.002455
## iter  80 value 5.975078
## iter  90 value 5.925403
## iter 100 value 5.876452
## final  value 5.876452
## stopped after 100 iterations
## # weights:  9
## initial  value 11.867081
## iter  10 value 6.624706
## iter  20 value 6.409236
## iter  30 value 6.407275
## final  value 6.406802
```

```
## converged
## # weights:  25
## initial  value 13.809805
## iter  10 value 6.898459
## iter  20 value 6.440532
## iter  30 value 6.413696
## iter  40 value 6.342254
## iter  50 value 6.230944
## iter  60 value 6.205142
## iter  70 value 6.142150
## iter  80 value 6.093271
## iter  90 value 6.038715
## iter 100 value 5.942289
## final  value 5.942289
## stopped after 100 iterations
## # weights:  41
## initial  value 10.705092
## iter  10 value 6.427530
## iter  20 value 6.282613
## iter  30 value 6.084137
## iter  40 value 6.036198
## iter  50 value 6.010974
## iter  60 value 5.980167
## iter  70 value 5.855332
## iter  80 value 5.787576
## iter  90 value 5.716148
## iter 100 value 5.671681
## final  value 5.671681
## stopped after 100 iterations
## # weights:  9
## initial  value 15.472998
## iter  10 value 8.875474
## iter  20 value 8.636059
## final  value 8.636019
## converged
## # weights:  25
## initial  value 14.176260
## iter  10 value 8.739416
## iter  20 value 8.421887
## iter  30 value 8.418395
## iter  40 value 8.416074
## final  value 8.416071
## converged
## # weights:  41
## initial  value 11.595295
## iter  10 value 8.468840
## iter  20 value 8.418921
## iter  30 value 8.414567
## iter  40 value 8.402332
## iter  50 value 8.388041
## iter  60 value 8.387890
## iter  60 value 8.387890
```

```
## iter  60 value 8.387890
## final   value 8.387890
## converged
## # weights:   9
## initial  value 11.742360
## iter  10 value 8.976862
## iter  20 value 6.437093
## iter  30 value 6.429009
## iter  40 value 6.420273
## iter  50 value 6.415800
## final   value 6.415799
## converged
## # weights:  25
## initial  value 33.893178
## iter  10 value 10.558344
## iter  20 value 9.838014
## iter  30 value 7.180742
## iter  40 value 6.438022
## iter  50 value 6.434623
## iter  60 value 6.422431
## iter  70 value 6.419664
## iter  80 value 6.416387
## iter  90 value 6.385938
## iter 100 value 6.324392
## final   value 6.324392
## stopped after 100 iterations
## # weights:  41
## initial  value 13.917957
## iter  10 value 6.534510
## iter  20 value 6.320427
## iter  30 value 6.237151
## iter  40 value 6.110465
## iter  50 value 5.808360
## iter  60 value 5.670797
## iter  70 value 5.625041
## iter  80 value 5.591669
## iter  90 value 5.578334
## iter 100 value 5.549898
## final   value 5.549898
## stopped after 100 iterations
## # weights:   9
## initial  value 13.564767
## iter  10 value 7.136205
## iter  20 value 6.854201
## iter  30 value 6.851395
## final   value 6.848757
## converged
## # weights:  25
## initial  value 10.884682
## iter  10 value 7.368101
## iter  20 value 6.837930
## iter  30 value 6.722436
```

```
## iter  40 value 6.570760
## iter  50 value 6.522113
## iter  60 value 6.480922
## iter  70 value 6.348581
## iter  80 value 6.279998
## iter  90 value 6.208859
## iter 100 value 6.126545
## final   value 6.126545
## stopped after 100 iterations
## # weights:  41
## initial   value 11.289839
## iter  10 value 6.915163
## iter  20 value 6.859043
## iter  30 value 6.603920
## iter  40 value 6.361957
## iter  50 value 6.189156
## iter  60 value 6.082531
## iter  70 value 5.999102
## iter  80 value 5.930091
## iter  90 value 5.905497
## iter 100 value 5.884223
## final   value 5.884223
## stopped after 100 iterations
## # weights:  9
## initial   value 16.246910
## iter  10 value 9.231607
## iter  20 value 9.157787
## iter  20 value 9.157787
## final   value 9.157787
## converged
## # weights:  25
## initial   value 11.532917
## iter  10 value 9.360455
## iter  20 value 8.944058
## iter  30 value 8.924001
## iter  40 value 8.922844
## iter  50 value 8.922144
## final   value 8.922143
## converged
## # weights:  41
## initial   value 29.996782
## iter  10 value 9.446181
## iter  20 value 8.916040
## iter  30 value 8.909813
## iter  40 value 8.907994
## iter  50 value 8.907635
## iter  60 value 8.907570
## iter  70 value 8.907537
## final   value 8.907524
## converged
## # weights:  9
## initial   value 11.138407
```

```
## iter  10 value 7.322876
## iter  20 value 6.861049
## iter  30 value 6.858153
## final   value 6.856332
## converged
## # weights:  25
## initial   value 14.566076
## iter  10 value 8.969431
## iter  20 value 6.889844
## iter  30 value 6.763713
## iter  40 value 6.598169
## iter  50 value 6.477876
## iter  60 value 6.405789
## iter  70 value 6.374282
## iter  80 value 6.349983
## iter  90 value 6.341620
## iter 100 value 6.317062
## final   value 6.317062
## stopped after 100 iterations
## # weights:  41
## initial   value 30.283239
## iter  10 value 7.684491
## iter  20 value 6.839051
## iter  30 value 6.679321
## iter  40 value 6.492191
## iter  50 value 6.284411
## iter  60 value 6.212310
## iter  70 value 6.124948
## iter  80 value 6.080732
## iter  90 value 6.048146
## iter 100 value 6.011421
## final   value 6.011421
## stopped after 100 iterations
## # weights:  9
## initial   value 17.431435
## iter  10 value 8.759475
## iter  20 value 6.672914
## iter  30 value 6.664705
## iter  40 value 6.658725
## final   value 6.658657
## converged
## # weights:  25
## initial   value 36.050155
## iter  10 value 6.775960
## iter  20 value 6.645069
## iter  30 value 6.584298
## iter  40 value 6.551708
## iter  50 value 6.393427
## iter  60 value 6.345797
## iter  70 value 6.330814
## iter  80 value 6.301056
## iter  90 value 6.287615
```

```
## iter 100 value 6.257199
## final   value 6.257199
## stopped after 100 iterations
## # weights:  41
## initial  value 15.053913
## iter  10 value 6.707557
## iter  20 value 6.550301
## iter  30 value 6.308326
## iter  40 value 6.245215
## iter  50 value 6.153188
## iter  60 value 6.059602
## iter  70 value 6.020519
## iter  80 value 5.990556
## iter  90 value 5.909380
## iter 100 value 5.863188
## final   value 5.863188
## stopped after 100 iterations
## # weights:  9
## initial  value 20.077138
## iter  10 value 10.265263
## iter  20 value 8.954367
## final   value 8.954088
## converged
## # weights:  25
## initial  value 14.901415
## iter  10 value 8.884999
## iter  20 value 8.735112
## iter  30 value 8.727488
## iter  40 value 8.726731
## final   value 8.726725
## converged
## # weights:  41
## initial  value 11.558908
## iter  10 value 8.800056
## iter  20 value 8.710304
## iter  30 value 8.706519
## iter  40 value 8.705466
## iter  50 value 8.705137
## iter  60 value 8.705099
## final   value 8.705095
## converged
## # weights:  9
## initial  value 14.234696
## iter  10 value 7.472071
## iter  20 value 6.676003
## iter  30 value 6.670124
## iter  40 value 6.667055
## final   value 6.667047
## converged
## # weights:  25
## initial  value 10.837229
## iter  10 value 6.738527
```

```
## iter  20 value 6.628314
## iter  30 value 6.472859
## iter  40 value 6.431314
## iter  50 value 6.418312
## iter  60 value 6.405889
## iter  70 value 6.380697
## iter  80 value 6.366809
## iter  90 value 6.354064
## iter 100 value 6.348163
## final  value 6.348163
## stopped after 100 iterations
## # weights:  41
## initial  value 21.706950
## iter  10 value 6.755315
## iter  20 value 6.523451
## iter  30 value 6.304321
## iter  40 value 6.155299
## iter  50 value 6.093815
## iter  60 value 6.062700
## iter  70 value 6.031646
## iter  80 value 6.001961
## iter  90 value 5.973318
## iter 100 value 5.953997
## final  value 5.953997
## stopped after 100 iterations
## # weights:  9
## initial  value 11.749883
## iter  10 value 6.663456
## iter  20 value 6.626525
## iter  30 value 6.616327
## iter  40 value 6.598779
## iter  50 value 6.597559
## iter  60 value 6.597503
## final  value 6.597503
## converged
## # weights:  25
## initial  value 12.680169
## iter  10 value 6.738558
## iter  20 value 6.570146
## iter  30 value 6.379668
## iter  40 value 6.226704
## iter  50 value 6.104195
## iter  60 value 6.081098
## iter  70 value 6.039134
## iter  80 value 6.017944
## iter  90 value 5.992000
## iter 100 value 5.975831
## final  value 5.975831
## stopped after 100 iterations
## # weights:  41
## initial  value 32.792984
## iter  10 value 6.668354
```

```
## iter   20 value 6.468760
## iter   30 value 6.331025
## iter   40 value 6.155660
## iter   50 value 5.997191
## iter   60 value 5.892648
## iter   70 value 5.744589
## iter   80 value 5.682746
## iter   90 value 5.630606
## iter  100 value 5.589530
## final   value 5.589530
## stopped after 100 iterations
## # weights:   9
## initial   value 14.713966
## iter   10 value 9.943178
## iter   20 value 8.860996
## final   value 8.860635
## converged
## # weights:  25
## initial   value 13.190832
## iter   10 value 8.749309
## iter   20 value 8.642086
## iter   30 value 8.633095
## iter   40 value 8.627693
## iter   50 value 8.627029
## final   value 8.627029
## converged
## # weights:  41
## initial   value 13.244891
## iter   10 value 8.746153
## iter   20 value 8.627910
## iter   30 value 8.619660
## iter   40 value 8.607328
## iter   50 value 8.606470
## iter   60 value 8.606376
## final   value 8.606373
## converged
## # weights:   9
## initial   value 10.792416
## iter   10 value 10.333613
## iter   20 value 6.689908
## iter   30 value 6.641986
## iter   40 value 6.635026
## iter   50 value 6.613498
## iter   60 value 6.607388
## final   value 6.607142
## converged
## # weights:  25
## initial   value 31.799142
## iter   10 value 7.552980
## iter   20 value 6.618132
## iter   30 value 6.487502
## iter   40 value 6.364574
```

```
## iter  50 value 6.140310
## iter  60 value 6.088746
## iter  70 value 6.070846
## iter  80 value 6.059256
## iter  90 value 6.044593
## iter 100 value 6.028225
## final  value 6.028225
## stopped after 100 iterations
## # weights:  41
## initial  value 21.589341
## iter  10 value 6.651056
## iter  20 value 6.501485
## iter  30 value 6.264721
## iter  40 value 6.108279
## iter  50 value 6.085308
## iter  60 value 6.062537
## iter  70 value 5.948634
## iter  80 value 5.886898
## iter  90 value 5.869209
## iter 100 value 5.846496
## final  value 5.846496
## stopped after 100 iterations
## # weights:  9
## initial  value 11.738449
## iter  10 value 7.349260
## iter  20 value 6.655603
## iter  30 value 6.653434
## iter  40 value 6.639034
## iter  50 value 6.638170
## iter  50 value 6.638170
## iter  50 value 6.638170
## final  value 6.638170
## converged
## # weights:  25
## initial  value 11.944559
## iter  10 value 6.657864
## iter  20 value 6.584866
## iter  30 value 6.286716
## iter  40 value 6.141734
## iter  50 value 6.053535
## iter  60 value 6.041180
## iter  70 value 6.010587
## iter  80 value 5.991966
## iter  90 value 5.987291
## iter 100 value 5.982321
## final  value 5.982321
## stopped after 100 iterations
## # weights:  41
## initial  value 16.000002
## iter  10 value 6.912920
## iter  20 value 6.398543
## iter  30 value 6.256359
```

```
## iter  40 value 6.124613
## iter  50 value 5.981287
## iter  60 value 5.900252
## iter  70 value 5.867001
## iter  80 value 5.845630
## iter  90 value 5.837922
## iter 100 value 5.829085
## final  value 5.829085
## stopped after 100 iterations
## # weights:  9
## initial  value 13.396619
## iter  10 value 9.642069
## iter  20 value 8.864319
## final  value 8.864130
## converged
## # weights:  25
## initial  value 12.154202
## iter  10 value 8.741649
## iter  20 value 8.645459
## iter  30 value 8.643494
## iter  40 value 8.643408
## final  value 8.643403
## converged
## # weights:  41
## initial  value 56.253343
## iter  10 value 9.238601
## iter  20 value 8.678129
## iter  30 value 8.616854
## iter  40 value 8.610869
## iter  50 value 8.608647
## iter  60 value 8.607688
## iter  70 value 8.606529
## iter  80 value 8.606469
## final  value 8.606469
## converged
## # weights:  9
## initial  value 12.671812
## iter  10 value 7.539904
## iter  20 value 6.660323
## iter  30 value 6.659323
## iter  40 value 6.648346
## iter  50 value 6.645761
## final  value 6.644663
## converged
## # weights:  25
## initial  value 10.803669
## iter  10 value 6.950094
## iter  20 value 6.604159
## iter  30 value 6.438717
## iter  40 value 6.309643
## iter  50 value 6.297111
## iter  60 value 6.288753
```

```
## iter  70 value 6.270152
## iter  80 value 6.240784
## iter  90 value 6.221300
## iter 100 value 6.211742
## final   value 6.211742
## stopped after 100 iterations
## # weights:  41
## initial   value 15.019702
## iter  10 value 6.730037
## iter  20 value 6.588744
## iter  30 value 6.385545
## iter  40 value 6.266195
## iter  50 value 6.143743
## iter  60 value 6.061118
## iter  70 value 6.010686
## iter  80 value 5.949701
## iter  90 value 5.925188
## iter 100 value 5.900902
## final   value 5.900902
## stopped after 100 iterations
## # weights:  9
## initial   value 14.421564
## iter  10 value 7.269962
## iter  20 value 6.930603
## iter  30 value 6.924578
## iter  40 value 6.916466
## final   value 6.916438
## converged
## # weights:  25
## initial   value 17.642250
## iter  10 value 7.015899
## iter  20 value 6.947065
## iter  30 value 6.924199
## iter  40 value 6.824849
## iter  50 value 6.617970
## iter  60 value 6.583952
## iter  70 value 6.502373
## iter  80 value 6.473554
## iter  90 value 6.449327
## iter 100 value 6.441109
## final   value 6.441109
## stopped after 100 iterations
## # weights:  41
## initial   value 21.071527
## iter  10 value 7.207724
## iter  20 value 6.798534
## iter  30 value 6.570211
## iter  40 value 6.416647
## iter  50 value 6.317676
## iter  60 value 6.264811
## iter  70 value 6.230165
## iter  80 value 6.182935
```

```
## iter  90 value 6.158963
## iter 100 value 6.136901
## final   value 6.136901
## stopped after 100 iterations
## # weights:  9
## initial   value 10.890111
## iter  10 value 9.219211
## iter  20 value 9.157539
## iter  20 value 9.157539
## final   value 9.157539
## converged
## # weights:  25
## initial   value 31.550908
## iter  10 value 9.140545
## iter  20 value 8.935113
## iter  30 value 8.932255
## iter  40 value 8.930893
## iter  50 value 8.928468
## final   value 8.928462
## converged
## # weights:  41
## initial   value 12.396576
## iter  10 value 9.241575
## iter  20 value 8.928002
## iter  30 value 8.909720
## iter  40 value 8.907961
## iter  50 value 8.907741
## iter  60 value 8.907555
## iter  70 value 8.907524
## final   value 8.907523
## converged
## # weights:  9
## initial   value 23.145641
## iter  10 value 10.765402
## iter  20 value 7.051228
## iter  30 value 6.964800
## iter  40 value 6.959700
## iter  50 value 6.940767
## iter  60 value 6.930244
## iter  70 value 6.926925
## final   value 6.926925
## converged
## # weights:  25
## initial   value 11.542184
## iter  10 value 6.974214
## iter  20 value 6.755156
## iter  30 value 6.654893
## iter  40 value 6.552372
## iter  50 value 6.518469
## iter  60 value 6.508831
## iter  70 value 6.491568
## iter  80 value 6.486541
```

```
## iter   90 value 6.451147
## iter  100 value 6.440982
## final    value 6.440982
## stopped after 100 iterations
## # weights:   41
## initial    value 11.109956
## iter   10 value 6.944140
## iter   20 value 6.813670
## iter   30 value 6.652596
## iter   40 value 6.557092
## iter   50 value 6.502582
## iter   60 value 6.470394
## iter   70 value 6.444627
## iter   80 value 6.405690
## iter   90 value 6.384154
## iter  100 value 6.326806
## final    value 6.326806
## stopped after 100 iterations
## # weights:   9
## initial    value 12.377499
## iter   10 value 7.962120
## iter   20 value 7.405036
## iter   30 value 7.395532
## iter   40 value 7.388658
## final    value 7.388639
## converged
```

```
summary(fit)
```

```
## a 6-1-1 network with 9 weights
## options were - decay=1e-04
##   b->h1 i1->h1 i2->h1 i3->h1 i4->h1 i5->h1 i6->h1
##    3.40  -6.76   2.54  -0.36  -2.01   0.86  -0.25
##   b->o h1->o
## -0.89  1.94
```

```
input = matrix(c(9, 6.54, 124, 0, 76, 110, 10), ncol=7)
colnames(input) = c('Sales','Price','Population','Advertising', 'Age', 'Income', 'Educat
ion')
prediction = predict(fit, input)
```

```
prediction
```

```
##            1
## 0.2914566
```