Tema5_Ejercicio

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2025-01-28

Tema 5 - Ejercicio

El dataset Carseats incluido en la librería ISLR incluye datos relativos a las ventas de sillitas de coche para niños de 400 establecimientos. Puede encontrarse información detallada sobre cada variable incluida el dataset en https://www.rdocumentation.org/packages/ISLR/versions/1.4/topics/Carseats.

Usando dicho dataset, construya un árbol de decisión, utilizando un 75% de la muestra como conjunto de entrenamiento, para predecir la variable Sales en base al resto de variables e interprete los resultados, comentando las reglas obtenidas.

Para realizar esta prueba, previamente se recomienda convertir Sales en una variable categórica usando la función ifelse. Para ello, será necesario establecer un punto de corte usando algún criterio predefinido (ie, valor por encima o por debajo de la media o la mediana).

Paso 1: Carga de los datos

```
#Load data from CRAN package ISLR
#install.packages("ISLR")
library("ISLR")
```

Carseats: Sales of Child Car Seats Description

A **simulated** data set containing sales of child car seats at 400 different stores.

Sales - Unit sales (in thousands) at each location

CompPrice - Price charged by competitor at each location

Income - Community income level (in thousands of dollars)

Advertising - Local advertising budget for company at each location (in thousands of dollars)

Population - Population size in region (in thousands)

Price - Price company charges for car seats at each site

ShelveLoc - A factor with levels Bad, Good and Medium indicating the quality of the shelving location for the car seats at each site

Age - Average age of the local population

Education - Education level at each location

Urban - A factor with levels No and Yes to indicate whether the store is in an urban or rural location

US - A factor with levels No and Yes to indicate whether the store is in the US or not

Paso 2: Explorar y preparar los datos

Carga de paquetes que son necesarios para diversas funciones.

```r
#install.packages("C50")  # Decision trees C5.0 algorithm
library(C50)

#install.packages("caret")  # data partitioning, confusion matrix
library(caret)
```

```
## Lade nötiges Paket: ggplot2
```

```
## Lade nötiges Paket: lattice
```

Examinamos la estructura y el aspecto del fichero importado:

```r
#See the structure
str(Carseats)
```

```
## 'data.frame':    400 obs. of  11 variables:
##  $ Sales      : num  9.5 11.22 10.06 7.4 4.15 ...
##  $ CompPrice  : num  138 111 113 117 141 124 115 136 132 132 ...
##  $ Income     : num  73 48 35 100 64 113 105 81 110 113 ...
##  $ Advertising: num  11 16 10 4 3 13 0 15 0 0 ...
##  $ Population : num  276 260 269 466 340 501 45 425 108 131 ...
##  $ Price      : num  120 83 80 97 128 72 108 120 124 124 ...
##  $ ShelveLoc  : Factor w/ 3 levels "Bad","Good","Medium": 1 2 3 3 1 1 3 2 3 3 ...
##  $ Age        : num  42 65 59 55 38 78 71 67 76 76 ...
##  $ Education  : num  17 10 12 14 13 16 15 10 10 17 ...
##  $ Urban      : Factor w/ 2 levels "No","Yes": 2 2 2 2 2 1 2 2 1 1 ...
##  $ US         : Factor w/ 2 levels "No","Yes": 2 2 2 2 1 2 1 2 1 2 ...
```

```r
#Summary
summary(Carseats)
```

```
##      Sales          CompPrice       Income        Advertising
##  Min.   : 0.000   Min.   : 77   Min.   : 21.00   Min.   : 0.000
##  1st Qu.: 5.390   1st Qu.:115   1st Qu.: 42.75   1st Qu.: 0.000
##  Median : 7.490   Median :125   Median : 69.00   Median : 5.000
##  Mean   : 7.496   Mean   :125   Mean   : 68.66   Mean   : 6.635
##  3rd Qu.: 9.320   3rd Qu.:135   3rd Qu.: 91.00   3rd Qu.:12.000
##  Max.   :16.270   Max.   :175   Max.   :120.00   Max.   :29.000
##    Population        Price         ShelveLoc        Age          Education
##  Min.   : 10.0   Min.   : 24.0   Bad   : 96   Min.   :25.00   Min.   :10.0
##  1st Qu.:139.0   1st Qu.:100.0   Good  : 85   1st Qu.:39.75   1st Qu.:12.0
##  Median :272.0   Median :117.0   Medium:219   Median :54.50   Median :14.0
##  Mean   :264.8   Mean   :115.8                Mean   :53.32   Mean   :13.9
##  3rd Qu.:398.5   3rd Qu.:131.0                3rd Qu.:66.00   3rd Qu.:16.0
##  Max.   :509.0   Max.   :191.0                Max.   :80.00   Max.   :18.0
##  Urban        US
##  No :118   No :142
##  Yes:282   Yes:258
```

```
##
##
##
##
```

La variable dependiente "Sales" es numérica. Para poder predecir si un carrito se venderá o no en función de las variables independientes, debemos transformarla en una variable categórica tipo Sí/No. Consideramos que si las ventas están por encima de la media será un "Sí", y si no, un "No":

```
#transform Sales into SalesFactor
sales_mean <- mean(Carseats$Sales)  # mean and median are almost the same

Carseats$SalesFactor <- factor(ifelse(Carseats$Sales>sales_mean,"Yes","No"))

table(Carseats$SalesFactor)
```

```
##
##  No Yes
## 201 199
```

```
#Check the result of the conversion
sum(Carseats$Sales > sales_mean)
```

```
## [1] 199
```

Eliminamos la columna original "sales"

```
#Remove sales variable
CarseatsNew <- Carseats[-1]
```

Ahora hay que crear los conjuntos de entrenamiento y de test. Aunque los datos en principio no vienen ordenados, para estar seguros vamos a crear estos dos conjuntos de manera aleatoria.

```
#Set seed to make the process reproducible
set.seed(9)

#partitioning data frame into training (75%) and testing (25%) sets
train_indices <- createDataPartition(CarseatsNew$SalesFactor, times=1, p=.75, list=FALSE)

#create training set
CarseatsNew_train <- CarseatsNew[train_indices, ]

#create testing set
CarseatsNew_test  <- CarseatsNew[-train_indices, ]

#create labels sets
CarseatsNew_train_labels <- CarseatsNew[train_indices, ]$SalesFactor
CarseatsNew_test_labels <- CarseatsNew[-train_indices, ]$SalesFactor

#view number of rows in each set
#nrow(CarseatsNew_train)  # 301
#nrow(CarseatsNew_test)   # 99
#length(CarseatsNew_train_labels)  # 301
#length(CarseatsNew_test_labels)   # 99
```

Comprobamos que la proporción se mantiene en los dos conjuntos:

```
#Check the proportion in both sets
prop.table(table(CarseatsNew_train$SalesFactor))
```

```
##
##        No       Yes
## 0.5016611 0.4983389
```

```
prop.table(table(CarseatsNew_test$SalesFactor))
```

```
##
##        No       Yes
## 0.5050505 0.4949495
```

Paso 3: Entrenamiento del modelo

```
# For the first iteration of the model, we use the default C5.0 settings

sales_model <- C5.0(SalesFactor ~ ., data = CarseatsNew_train)

sales_model
```

```
##
## Call:
## C5.0.formula(formula = SalesFactor ~ ., data = CarseatsNew_train)
##
## Classification Tree
## Number of samples: 301
## Number of predictors: 10
##
## Tree size: 19
##
## Non-standard options: attempt to group attributes
```

Para examinar el modelo (el árbol), utilizamos la función summary:

```
# To see the tree's decisions, we can call the summary() function on the model:

summary(sales_model)
```

```
##
## Call:
## C5.0.formula(formula = SalesFactor ~ ., data = CarseatsNew_train)
##
##
## C5.0 [Release 2.07 GPL Edition]      Wed Feb 12 13:40:07 2025
## -------------------------------
##
```

```
## Class specified by attribute 'outcome'
##
## Read 301 cases (11 attributes) from undefined.data
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 135: Yes (51/1)
## :    Price > 135:
## :    :...Income <= 75: No (7/1)
## :         Income > 75: Yes (5/1)
## ShelveLoc in {Bad,Medium}:
## :...Price > 105:
##     :...CompPrice <= 142:
##     :    :...Advertising <= 10: No (86/6)
##     :    :    Advertising > 10:
##     :    :    :...Price > 126: No (22/2)
##     :    :         Price <= 126:
##     :    :         :...CompPrice <= 121: No (9/1)
##     :    :              CompPrice > 121: Yes (15)
##     :    CompPrice > 142:
##     :    :...Urban = No: No (4/1)
##     :         Urban = Yes:
##     :         :...Education <= 13: Yes (6)
##     :              Education > 13:
##     :              :...Price <= 127: Yes (5)
##     :                   Price > 127: No (9/3)
##     Price <= 105:
##     :...CompPrice > 123: Yes (20)
##         CompPrice <= 123:
##         :...Income > 100: Yes (12)
##             Income <= 100:
##             :...Age <= 35: Yes (8)
##                 Age > 35:
##                 :...Price <= 70: Yes (5)
##                     Price > 70:
##                     :...US = No: No (14/1)
##                         US = Yes:
##                         :...Population > 272: No (10/1)
##                             Population <= 272:
##                             :...CompPrice <= 103: No (3)
##                                  CompPrice > 103: Yes (10/1)
##
##
## Evaluation on training data (301 cases):
##
##     Decision Tree
##     ----------------
##     Size      Errors
##
##      19   19( 6.3%)   <<
##
##
##     (a)   (b)    <-classified as
```

```
##     ----  ----
##      148    3    (a): class No
##       16  134    (b): class Yes
##
##
##   Attribute usage:
##
##   100.00% Price
##   100.00% ShelveLoc
##    79.07% CompPrice
##    43.85% Advertising
##    24.58% Income
##    16.61% Age
##    12.29% US
##     7.97% Urban
##     7.64% Population
##     6.64% Education
##
##
## Time: 0.0 secs
```

...

Decision tree:

ShelveLoc = Good: <- (i) :...Price <= 135: Yes (51/1) : Price > 135: <- (ii) : :...Income <= 75: No (7/1) : Income > 75: Yes (5/1) ShelveLoc in {Bad,Medium}: :...Price > 105: :...CompPrice <= 142: <- (iii)

  (i)   Si el estado del expositor/estantería es bueno y el precio es menor o igual de 135, 51 sillitas de coche se venden (1 en realidad no)
  (ii) Si el estado del expositor/estantería es bueno y el precio es superior a 135, entonces ya influyen los ingresos del comprador
  (iii) Si el estado del expositor/estantería no es bueno y el precio es superior a 105, entonces entran en juego otros factores como el precio del mismo carrito en otro comercio, la publicidad ..

El resultado con el conjunto de entrenamiento parece bastante bueno, solo un 6.3% de errores. (Teniendo en cuenta esto, que se trata del conjunto de entrenamiento y los árboles de decisión son propensos al sobreajuste). Las variables más importantes han sido el precio y el estado de la estantería/expositor (si he entendido bien la descripción de "ShelveLoc"). Variables como como el total de la población, el nivel de su educación, si es un area urbana .. no parecen muy influyentes.

Visualización del árbol:

```
#plotting the model

#plot(sales_model)  <- done in another R script for better visualization
```

Paso 4: Evaluación del modelo

Realizamos la predicción con los datos nuevos.

```
#Prediction

sales_pred <- predict(sales_model, CarseatsNew_test)
```

Y comparamos lo predicho por el algoritmo con los datos etiquetados anteriormente

```
#confusion matrix
confusionMatrix(reference = CarseatsNew_test_labels, data = sales_pred, mode = "everything", positive =
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction No Yes
##        No  41  16
##        Yes  9  33
##
##                Accuracy : 0.7475
##                  95% CI : (0.6502, 0.8294)
##     No Information Rate : 0.5051
##     P-Value [Acc > NIR] : 7.008e-07
##
##                   Kappa : 0.4942
##
##  Mcnemar's Test P-Value : 0.2301
##
##             Sensitivity : 0.6735
##             Specificity : 0.8200
##          Pos Pred Value : 0.7857
##          Neg Pred Value : 0.7193
##               Precision : 0.7857
##                  Recall : 0.6735
##                      F1 : 0.7253
##              Prevalence : 0.4949
##          Detection Rate : 0.3333
##    Detection Prevalence : 0.4242
##       Balanced Accuracy : 0.7467
##
##        'Positive' Class : Yes
##
```

Al aplicar el modelo a datos nuevos, en cambio se obtiene una exactitud del 75%, (un error ahora del 25%).
Como sospechábamos, aquí se da un caso de sobreajuste a los datos de entrenamiento.

Paso 5: Mejora del modelo

Entiendo que en este caso, en el que se intenta predecir las ventas de sillitas para bebés, no es equivalente
al ejemplo del libro, donde se puede dar el caso de conceder un préstamo a alguien que no lo va a poder
devolver, o algún tema relacionado con la salud, donde también puede tener consecuencias muy graves que
el modelo devuelva muchos falsos negativos. Así que solo voy a aplicar la técnica de boosting, y no la de
considerar algunos errores más costosos que otros.

La función C5.0 permite aplicar la técnica de boosting simplemente añadiendo un parámetro como se puede
ver a continuación. Este parámetro indica el número de árboles a usar. Es un límite "por arriba", el algoritmo
dejará de añadir árboles en cuanto detecte que no se está mejorando la exactitud.

```r
# boosting, we use the C5.0 parameter trials and set it to 100

sales_model_boost100 <- C5.0(SalesFactor ~ ., data = CarseatsNew_train, trials = 100)  # trials = 10

sales_model_boost100
```

```
## 
## Call:
## C5.0.formula(formula = SalesFactor ~ ., data = CarseatsNew_train, trials = 100)
## 
## Classification Tree
## Number of samples: 301
## Number of predictors: 10
## 
## Number of boosting iterations: 100
## Average tree size: 16.2
## 
## Non-standard options: attempt to group attributes
```

```r
# To see the tree's decisions, we can call the summary() function on the model:

summary(sales_model_boost100)
```

```
## 
## Call:
## C5.0.formula(formula = SalesFactor ~ ., data = CarseatsNew_train, trials = 100)
## 
## 
## C5.0 [Release 2.07 GPL Edition]      Wed Feb 12 13:40:08 2025
## -------------------------------
## 
## Class specified by attribute 'outcome'
## 
## Read 301 cases (11 attributes) from undefined.data
## 
## -----  Trial 0:  -----
## 
## Decision tree:
## 
## ShelveLoc = Good:
## :...Price <= 135: Yes (51/1)
## :   Price > 135:
## :   :...Income <= 75: No (7/1)
## :       Income > 75: Yes (5/1)
## ShelveLoc in {Bad,Medium}:
## :...Price > 105:
##     :...CompPrice <= 142:
##     :   :...Advertising <= 10: No (86/6)
##     :   :   Advertising > 10:
##     :   :   :...Price > 126: No (22/2)
##     :   :       Price <= 126:
##     :   :          :...CompPrice <= 121: No (9/1)
##     :   :              CompPrice > 121: Yes (15)
```

```
##     :    CompPrice > 142:
##     :    :...Urban = No: No (4/1)
##     :         Urban = Yes:
##     :         :...Education <= 13: Yes (6)
##     :             Education > 13:
##     :             :...Price <= 127: Yes (5)
##     :                 Price > 127: No (9/3)
##     Price <= 105:
##     :...CompPrice > 123: Yes (20)
##         CompPrice <= 123:
##         :...Income > 100: Yes (12)
##             Income <= 100:
##             :...Age <= 35: Yes (8)
##                 Age > 35:
##                 :...Price <= 70: Yes (5)
##                     Price > 70:
##                     :...US = No: No (14/1)
##                         US = Yes:
##                         :...Population > 272: No (10/1)
##                             Population <= 272:
##                             :...CompPrice <= 103: No (3)
##                                 CompPrice > 103: Yes (10/1)
##
## -----  Trial 1:  -----
##
## Decision tree:
##
## Age > 76: No (18.4/2.3)
## Age <= 76:
## :...ShelveLoc = Bad:
##     :...CompPrice <= 151: No (47.5/11.5)
##     :   CompPrice > 151: Yes (6/0.8)
##     ShelveLoc in {Good,Medium}:
##     :...Price <= 100: Yes (48/3.8)
##         Price > 100:
##         :...CompPrice <= 114: No (35.6/8.4)
##             CompPrice > 114:
##             :...ShelveLoc = Good:
##                 :...Price <= 156: Yes (28.2)
##                 :   Price > 156: No (2.3)
##                 ShelveLoc = Medium:
##                 :...Age <= 33: Yes (27.7/1.5)
##                     Age > 33:
##                     :...CompPrice > 142: Yes (24.1/3.1)
##                         CompPrice <= 142:
##                         :...Price > 127: No (23)
##                             Price <= 127:
##                             :...Population <= 199: No (10.7/3.1)
##                                 Population > 199: Yes (29.3/5.4)
##
## -----  Trial 2:  -----
##
## Decision tree:
##
```

```
## Advertising > 7:
## :...ShelveLoc = Good: Yes (29/1.2)
## :    ShelveLoc in {Bad,Medium}:
## :    :...Price <= 105: Yes (39.4/3)
## :        Price > 105:
## :        :...US = No: Yes (3.5)
## :            US = Yes:
## :            :...Advertising > 21: Yes (10.1)
## :                Advertising <= 21:
## :                :...Education <= 10: Yes (10.2/1.2)
## :                    Education > 10:
## :                    :...Price > 126: No (15.7)
## :                        Price <= 126:
## :                        :...Price <= 111: No (6.7)
## :                            Price > 111: Yes (21.8/4.9)
## Advertising <= 7:
## :...Price > 144: No (19.9/1.2)
##     Price <= 144:
##     :...ShelveLoc = Good: Yes (19.9/4.1)
##         ShelveLoc in {Bad,Medium}:
##         :...US = Yes:
##             :...Age <= 41: Yes (10.1/1.8)
##             :   Age > 41: No (30.8/4.2)
##             US = No:
##             :...Price <= 72: Yes (7.3)
##                 Price > 72:
##                 :...CompPrice <= 120: No (20/1.8)
##                     CompPrice > 120:
##                     :...Advertising > 2: Yes (13/1.8)
##                         Advertising <= 2:
##                         :...Price > 127: No (6.6)
##                             Price <= 127:
##                             :...Age <= 66: Yes (31.6/7.3)
##                                 Age > 66: No (5.5)
##
## -----  Trial 3:  -----
##
## Decision tree:
##
## Price <= 100:
## :...Income <= 25: No (4)
## :   Income > 25: Yes (66.3/11.6)
## Price > 100:
## :...ShelveLoc = Bad:
##     :...US = No: No (22.1/0.5)
##     :   US = Yes:
##     :   :...Education > 16: Yes (7/1.4)
##     :       Education <= 16:
##     :       :...Advertising <= 15: No (20.5)
##     :           Advertising > 15: Yes (5.7/1.4)
##     ShelveLoc in {Good,Medium}:
##     :...Income <= 61:
##         :...Advertising <= 3: No (32.1/1.9)
##         :   Advertising > 3:
```

```
##             :    :...CompPrice <= 110: No (6.8)
##             :         CompPrice > 110:
##             :            :...Price <= 141: Yes (35.1/12.3)
##             :                Price > 141: No (5.4)
##         Income > 61:
##         :...ShelveLoc = Good: Yes (25.4/3.2)
##             ShelveLoc = Medium:
##             :...Age <= 33: Yes (12/0.5)
##                 Age > 33:
##                 :...Population <= 391: No (31.4/8)
##                     Population > 391:
##                     :...Advertising <= 1: No (3.3)
##                         Advertising > 1: Yes (23.7/2.8)
##
## -----  Trial 4:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Urban = No: No (17.9/6.7)
## :   Urban = Yes:
## :   :...Age <= 73: Yes (26.2/0.7)
## :       Age > 73: No (3.6/0.4)
## ShelveLoc in {Bad,Medium}:
## :...Income > 100:
##     :...Price <= 115: Yes (21.6/0.4)
##     :   Price > 115: No (9.7/3.3)
##     Income <= 100:
##     :...CompPrice > 131:
##         :...Price <= 119: Yes (17.9/0.7)
##         :   Price > 119:
##         :   :...Advertising > 14: Yes (5.1)
##         :       Advertising <= 14:
##         :       :...CompPrice <= 144: No (24.7/4.1)
##         :           CompPrice > 144: Yes (19.8/7.2)
##         CompPrice <= 131:
##         :...Price <= 80: Yes (9/1.5)
##             Price > 80:
##             :...ShelveLoc = Bad: No (49.8/5.7)
##                 ShelveLoc = Medium:
##                 :...Price > 132: No (11.7)
##                     Price <= 132:
##                     :...Population > 492: Yes (5.5/0.4)
##                         Population <= 492:
##                         :...US = No: No (15.3/0.7)
##                             US = Yes:
##                             :...Income <= 27: Yes (4.4)
##                                 Income > 27:
##                                 :...Age <= 49: Yes (13.2/5.3)
##                                     Age > 49: No (45.5/9.3)
##
## -----  Trial 5:  -----
##
## Decision tree:
```

```
##
## ShelveLoc = Good:
## :...Price <= 135: Yes (40/3.2)
## :   Price > 135: No (15.9/5)
## ShelveLoc in {Bad,Medium}:
## :...Price > 126:
##     :...Advertising <= 23: No (61.5/7.8)
##     :   Advertising > 23: Yes (3.8)
##     Price <= 126:
##     :...CompPrice > 123:
##         :...Advertising > 3: Yes (33.1/0.9)
##         :   Advertising <= 3:
##         :   :...Age > 70: No (3.9)
##         :       Age <= 70:
##         :       :...Population > 264: Yes (13.8/0.3)
##         :           Population <= 264:
##         :           :...CompPrice <= 131: No (7)
##         :               CompPrice > 131: Yes (15.1/5.1)
##         CompPrice <= 123:
##         :...Income <= 59: No (40.6/5.3)
##             Income > 59:
##             :...Price <= 86: Yes (8.6)
##                 Price > 86:
##                 :...Urban = No: Yes (16/3.5)
##                     Urban = Yes:
##                     :...US = No: No (8.5)
##                         US = Yes:
##                         :...Age <= 68: Yes (22.2/8)
##                             Age > 68: No (11)
##
## -----  Trial 6:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Income <= 42: No (16.1/6.1)
## :   Income > 42: Yes (39/3.4)
## ShelveLoc in {Bad,Medium}:
## :...Education <= 10:
##     :...Age <= 72: Yes (22.3/4.3)
##     :   Age > 72: No (4)
##     Education > 10:
##     :...Price <= 104:
##         :...CompPrice > 118: Yes (23.3/2.5)
##         :   CompPrice <= 118:
##         :   :...Advertising > 7: Yes (19.8/5.1)
##         :       Advertising <= 7:
##         :       :...Price <= 70: Yes (3.4)
##         :           Price > 70: No (27.5/4.6)
##         Price > 104:
##         :...CompPrice <= 114: No (20.1)
##             CompPrice > 114:
##             :...ShelveLoc = Bad:
##                 :...Income <= 41: Yes (6.1/1.2)
```

```
##                      :    Income > 41: No (36.1/5)
##                      ShelveLoc = Medium:
##                      :...Income <= 74: No (52/15.3)
##                          Income > 74: Yes (31.3/10.2)
##
## -----  Trial 7:  -----
##
## Decision tree:
##
## ShelveLoc = Good: Yes (55.8/12.9)
## ShelveLoc in {Bad,Medium}:
## :...Age <= 49:
##     :...Price <= 119: Yes (47/9.5)
##     :   Price > 119:
##     :   :...Urban = No: No (16.3/2.2)
##     :        Urban = Yes:
##     :        :...US = No: No (8.8/1)
##     :            US = Yes:
##     :            :...CompPrice <= 134: No (15.2/4.5)
##     :                CompPrice > 134: Yes (21.6/4.6)
##     Age > 49:
##     :...CompPrice > 147: Yes (10.9/2.2)
##         CompPrice <= 147:
##         :...Price <= 102:
##             :...Advertising > 11: Yes (4.4)
##             :   Advertising <= 11:
##             :   :...CompPrice <= 109: No (15.2/1.8)
##             :       CompPrice > 109: Yes (27.3/10.1)
##             Price > 102:
##             :...CompPrice <= 123: No (37.9/1.1)
##                 CompPrice > 123:
##                 :...Price > 127: No (13.1)
##                     Price <= 127:
##                     :...Advertising <= 3: No (14.5/0.8)
##                         Advertising > 3: Yes (13/2)
##
## -----  Trial 8:  -----
##
## Decision tree:
##
## Advertising > 7:
## :...Price <= 89: Yes (11.2)
## :   Price > 89:
## :   :...Advertising > 21: Yes (7.6)
## :       Advertising <= 21:
## :       :...ShelveLoc = Good: Yes (17.9/3.7)
## :           ShelveLoc in {Bad,Medium}:
## :           :...CompPrice > 134: Yes (18.6/3)
## :               CompPrice <= 134:
## :               :...Price > 126: No (15.6)
## :                   Price <= 126:
## :                   :...Income > 97: Yes (9.2)
## :                       Income <= 97:
## :                       :...CompPrice <= 111: No (15.1/0.6)
```

```
## :                                       CompPrice > 111: Yes (21/9)
## Advertising <= 7:
## :...Age > 76: No (15.9)
##     Age <= 76:
##     :...Price <= 72: Yes (12.8/2.6)
##         Price > 72:
##         :...CompPrice <= 109: No (14.3)
##             CompPrice > 109:
##             :...ShelveLoc = Good:
##                 :...Price <= 150: Yes (13.9)
##                 :   Price > 150: No (9.7/1.9)
##                 ShelveLoc in {Bad,Medium}:
##                 :...ShelveLoc = Bad: No (32.9/6.6)
##                     ShelveLoc = Medium:
##                     :...Age > 71: Yes (6.6/0.5)
##                         Age <= 71:
##                         :...Price > 125: No (20.7/1.8)
##                             Price <= 125:
##                             :...CompPrice > 142: Yes (6.1)
##                                 CompPrice <= 142:
##                                 :...Population <= 119: No (16.6/1.7)
##                                     Population > 119:
##                                     :...Education <= 10: No (3.2)
##                                         Education > 10:
##                                         :...Advertising > 4: Yes (4.4)
##                                             Advertising <= 4:
##                                             :...Advertising > 3: No (4.5)
##                                                 Advertising <= 3:
##                                                 :...Income <= 62: No (13/3.5)
##                                                     Income > 62: Yes (10.2)
##
## -----  Trial 9:  -----
##
## Decision tree:
##
## Age > 73: No (39/5.7)
## Age <= 73:
## :...Price <= 104:
##     :...CompPrice > 121: Yes (22.9)
##     :   CompPrice <= 121:
##     :   :...Urban = No: Yes (19/2.1)
##     :       Urban = Yes:
##     :       :...Price <= 70: Yes (6.6)
##     :           Price > 70:
##     :           :...Advertising <= 7: No (25/4.2)
##     :               Advertising > 7: Yes (8.7/1.1)
##     Price > 104:
##     :...CompPrice <= 131:
##         :...Advertising <= 10: No (56.9/7.2)
##         :   Advertising > 10:
##         :   :...Income > 99: Yes (7.5/0.1)
##         :       Income <= 99:
##         :       :...Advertising <= 20: No (25.1/6.4)
##         :           Advertising > 20: Yes (3.8)
```

```
##          CompPrice > 131:
##          :...ShelveLoc = Good: Yes (15.5/1.4)
##              ShelveLoc in {Bad,Medium}:
##              :...Price > 139: No (18.8/1.3)
##                  Price <= 139:
##                  :...Urban = No: No (7/2.3)
##                      Urban = Yes: Yes (45.3/13.9)
##
## -----  Trial 10:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 135: Yes (35.7/3)
## :   Price > 135: No (21.2/6.7)
## ShelveLoc = Bad:
## :...Price > 129: No (15)
## :   Price <= 129:
## :   :...Income <= 101: No (55/17.7)
## :       Income > 101: Yes (7.6/0.7)
## ShelveLoc = Medium:
## :...Price <= 86: Yes (8.9)
##     Price > 86:
##     :...Age <= 33: Yes (25.9/4.5)
##         Age > 33:
##         :...CompPrice > 142: Yes (20.1/4.7)
##             CompPrice <= 142:
##             :...Price > 127: No (24.8)
##                 Price <= 127:
##                 :...Education > 13: No (39.2/11.6)
##                     Education <= 13:
##                     :...Price <= 100: Yes (16.5/2.7)
##                         Price > 100:
##                         :...CompPrice <= 123: No (13.8/0.6)
##                             CompPrice > 123: Yes (17.2/4.6)
##
## -----  Trial 11:  -----
##
## Decision tree:
##
## Price <= 103:
## :...Income <= 25: No (4.8)
## :   Income > 25:
## :   :...CompPrice > 123: Yes (19.9)
## :       CompPrice <= 123:
## :       :...ShelveLoc = Good: Yes (7.4)
## :           ShelveLoc in {Bad,Medium}:
## :           :...Age <= 37: Yes (10.2)
## :               Age > 37:
## :               :...Advertising > 7: Yes (15.8/1.8)
## :                   Advertising <= 7:
## :                   :...Urban = No: Yes (7.1/1.2)
## :                       Urban = Yes: No (23.2/6.3)
## Price > 103:
```

```
## :...ShelveLoc = Good:
##     :...Price <= 156: Yes (39.4/10.4)
##     :   Price > 156: No (5.1)
##     ShelveLoc in {Bad,Medium}:
##     :...Advertising > 15: Yes (21/5.9)
##         Advertising <= 15:
##         :...Price > 144: No (17.5)
##             Price <= 144:
##             :...CompPrice > 142: Yes (26.5/7.8)
##                 CompPrice <= 142:
##                 :...ShelveLoc = Bad: No (24/2)
##                     ShelveLoc = Medium:
##                     :...Price > 125: No (16.7/1.1)
##                         Price <= 125:
##                         :...Education <= 12: No (20.7/3.1)
##                             Education > 12:
##                             :...CompPrice <= 115: No (9.9/1.3)
##                                 CompPrice > 115: Yes (31.7/9.2)
##
## -----  Trial 12:  -----
##
## Decision tree:
##
## Price <= 102: Yes (77.9/21.2)
## Price > 102:
## :...ShelveLoc = Bad:
##     :...Education <= 16: No (38.2/5.6)
##     :   Education > 16: Yes (8.9/2.6)
##     ShelveLoc = Good:
##     :...Education > 16: Yes (7.5)
##     :   Education <= 16:
##     :   :...Urban = No: No (17.7/3.8)
##     :       Urban = Yes: Yes (19.8/6.7)
##     ShelveLoc = Medium:
##     :...Age <= 49:
##         :...Education <= 17: Yes (49/17.9)
##         :   Education > 17: No (7.2/0.5)
##         Age > 49:
##         :...CompPrice <= 123: No (24.9/1.7)
##             CompPrice > 123:
##             :...Price <= 109: Yes (4)
##                 Price > 109:
##                 :...Urban = No: No (16.3/1.7)
##                     Urban = Yes:
##                     :...Education <= 16: Yes (18.6/6.5)
##                         Education > 16: No (11.1)
##
## -----  Trial 13:  -----
##
## Decision tree:
##
## Price > 127:
## :...ShelveLoc in {Bad,Medium}:
## :   :...Advertising <= 23: No (64.4/9.4)
```

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```
## :    :    Advertising > 23: Yes (2.8)
## :    ShelveLoc = Good:
## :    :...Price <= 135: Yes (5.4)
## :        Price > 135:
## :        :...Population <= 97: Yes (3.7)
## :            Population > 97: No (19.7/3.5)
## Price <= 127:
## :...CompPrice > 139: Yes (11.2)
##     CompPrice <= 139:
##     :...ShelveLoc = Good: Yes (20.4/4.2)
##         ShelveLoc in {Bad,Medium}:
##         :...Age > 67: No (44.3/9.6)
##             Age <= 67:
##             :...Advertising > 10:
##                 :...Income <= 35: No (8/2.5)
##                 :   Income > 35: Yes (27.1/1.5)
##                 Advertising <= 10:
##                 :...Price <= 100:
##                     :...Education <= 13: Yes (22.8/2.1)
##                     :   Education > 13: No (20.6/8.6)
##                     Price > 100:
##                     :...ShelveLoc = Bad: No (9.1)
##                         ShelveLoc = Medium:
##                         :...Education <= 12: No (12.7)
##                             Education > 12:
##                             :...Income > 95: Yes (4)
##                                 Income <= 95:
##                                 :...Income <= 28: Yes (2.6)
##                                     Income > 28: No (22.1/3.3)
##
## -----  Trial 14:  -----
##
## Decision tree:
##
## Price <= 80: Yes (24.2/2.2)
## Price > 80:
## :...CompPrice <= 121:
##     :...US = No: No (37.3/4.8)
##     :   US = Yes:
##     :   :...ShelveLoc = Bad: No (12.1/1.8)
##     :       ShelveLoc = Good: Yes (11.1/4.4)
##     :       ShelveLoc = Medium:
##     :       :...Price > 116: No (13.9/0.8)
##     :           Price <= 116:
##     :           :...Urban = No: Yes (9.7/0.9)
##     :               Urban = Yes:
##     :               :...CompPrice <= 116: Yes (17.7/5.9)
##     :                   CompPrice > 116: No (6.1)
##     CompPrice > 121:
##     :...Price <= 104: Yes (24.5/1.3)
##         Price > 104:
##         :...Education <= 10: Yes (19.4/2.5)
##             Education > 10:
##             :...Income <= 36: No (13.1/0.6)
```

```
##                    Income > 36:
##                    :...ShelveLoc = Good: Yes (18.1/1.9)
##                        ShelveLoc in {Bad,Medium}:
##                        :...Price <= 125:
##                            :...Advertising > 10: Yes (16.3)
##                            :   Advertising <= 10:
##                            :   :...US = No: Yes (25.7/11.4)
##                            :       US = Yes: No (7.4)
##                            Price > 125:
##                            :...CompPrice <= 142: No (19.8)
##                                CompPrice > 142:
##                                :...Education <= 17: No (16.4/4.3)
##                                    Education > 17: Yes (8.5/0.8)
##
## -----  Trial 15:  -----
##
## Decision tree:
##
## Price <= 100:
## :...ShelveLoc in {Good,Medium}: Yes (49.8/9.7)
## :    ShelveLoc = Bad:
## :    :...Income <= 50: No (12/1)
## :        Income > 50: Yes (21.4/5.4)
## Price > 100:
## :...Advertising <= 2:
##     :...CompPrice <= 147: No (71.5/10.8)
##     :   CompPrice > 147: Yes (10.3/3)
##     Advertising > 2:
##     :...US = No: Yes (13.8/2)
##         US = Yes:
##         :...Advertising > 21: Yes (7.7)
##             Advertising <= 21:
##             :...Price > 141: No (16.9/2)
##                 Price <= 141:
##                 :...ShelveLoc = Good: Yes (16.9/3.4)
##                     ShelveLoc in {Bad,Medium}:
##                     :...Education <= 10: Yes (14.6/2.2)
##                         Education > 10:
##                         :...Price > 129: No (8.4)
##                             Price <= 129:
##                             :...Income > 98: Yes (7.2/0.7)
##                                 Income <= 98:
##                                 :...Income > 76: No (10)
##                                     Income <= 76:
##                                     :...Age <= 48: Yes (13.8/3.2)
##                                         Age > 48:
##                                         :...Income > 75: Yes (2.1)
##                                             Income <= 75:
##                                             :...Price <= 101: Yes (2.1)
##                                                 Price > 101: No (22.5/2.6)
##
## -----  Trial 16:  -----
##
## Decision tree:
```

```
## 
## ShelveLoc = Good:
## :...CompPrice <= 107: No (9.3/1.2)
## :    CompPrice > 107: Yes (44.1/9.2)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 86: Yes (22.5/4.6)
##     Price > 86:
##     :...Advertising > 7:
##         :...Advertising > 21: Yes (6.6)
##         :    Advertising <= 21:
##         :    :...ShelveLoc = Bad: No (20.9/6.3)
##         :        ShelveLoc = Medium:
##         :        :...Price <= 103: Yes (8)
##         :            Price > 103:
##         :            :...CompPrice <= 122: No (19.8/2.2)
##         :                CompPrice > 122: Yes (28.3/7.9)
##         Advertising <= 7:
##         :...Age > 76: No (17.2)
##             Age <= 76:
##             :...Population <= 66: No (16.5/0.5)
##                 Population > 66:
##                 :...Price > 144: No (8.2)
##                     Price <= 144:
##                     :...CompPrice > 143: Yes (16.4/3.1)
##                         CompPrice <= 143:
##                         :...Price > 125: No (14)
##                             Price <= 125:
##                             :...Urban = No: Yes (19.6/8.2)
##                                 Urban = Yes:
##                                 :...CompPrice <= 129: No (38.8/6.9)
##                                     CompPrice > 129: Yes (10.8/1.3)
## 
## -----  Trial 17:  -----
## 
## Decision tree:
## 
## ShelveLoc = Good:
## :...Price <= 135: Yes (31.5/2.8)
## :    Price > 135: No (24.6/6.6)
## ShelveLoc in {Bad,Medium}:
## :...Price > 104:
##     :...CompPrice <= 114: No (14.8)
##     :    CompPrice > 114:
##     :    :...Advertising <= 10:
##     :        :...CompPrice <= 144: No (71.7/10.1)
##     :        :    CompPrice > 144:
##     :        :    :...Price <= 147: Yes (17.3/4.9)
##     :        :        Price > 147: No (5.9)
##     :        Advertising > 10:
##     :        :...Price <= 126: Yes (19.8/2.1)
##     :            Price > 126:
##     :            :...Advertising <= 23: No (19.9/2.6)
##     :                Advertising > 23: Yes (3.6)
##     Price <= 104:
```

```
##      :...CompPrice > 123: Yes (16.7)
##          CompPrice <= 123:
##          :...Age <= 35: Yes (11.8)
##              Age > 35:
##              :...Income <= 48: No (16.2/0.2)
##                  Income > 48:
##                  :...Urban = No: Yes (6.7)
##                      Urban = Yes:
##                      :...Price <= 86: Yes (7.6)
##                          Price > 86: No (32.9/10.3)
##
## -----  Trial 18:  -----
##
## Decision tree:
##
## Age > 73: No (34.4/7)
## Age <= 73:
## :...ShelveLoc = Bad:
##     :...Advertising <= 14: No (46.1/12.6)
##     :   Advertising > 14: Yes (9/0.6)
##     ShelveLoc = Good:
##     :...Urban = No: No (17.7/7.1)
##     :   Urban = Yes:
##     :   :...Price <= 156: Yes (32)
##     :       Price > 156: No (2.7)
##     ShelveLoc = Medium:
##     :...Price > 135: No (19.7/2.9)
##         Price <= 135:
##         :...Income > 100: Yes (17.2/0.8)
##             Income <= 100:
##             :...CompPrice > 140: Yes (9.1)
##                 CompPrice <= 140:
##                 :...Price <= 101:
##                     :...Income <= 92: Yes (41.1/7.1)
##                     :   Income > 92: No (3.7)
##                     Price > 101:
##                     :...Age <= 33: Yes (19.9/5.3)
##                         Age > 33:
##                         :...CompPrice <= 123: No (17.8)
##                             CompPrice > 123:
##                             :...Price <= 124: Yes (18.7/6.1)
##                                 Price > 124: No (12.1/0.6)
##
## -----  Trial 19:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price > 156: No (4.2)
## :   Price <= 156:
## :   :...Urban = Yes: Yes (29/1.5)
## :       Urban = No:
## :       :...Price > 133: No (5.6)
## :           Price <= 133:
```

```
## :           :...CompPrice <= 100: No (4)
## :             CompPrice > 100: Yes (19.9)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 104:
##     :...CompPrice > 123: Yes (15.9)
##     :   CompPrice <= 123:
##     :   :...Income <= 34: No (7.1)
##     :       Income > 34:
##     :       :...Advertising > 7: Yes (26.2/2)
##     :           Advertising <= 7:
##     :           :...Advertising > 5: No (5.9)
##     :               Advertising <= 5:
##     :               :...Age <= 67: Yes (27.2/8.4)
##     :                   Age > 67: No (7.7/0.8)
##     Price > 104:
##     :...CompPrice <= 114: No (15.8)
##         CompPrice > 114:
##         :...Population <= 51: No (8.4/0.1)
##             Population > 51:
##             :...ShelveLoc = Bad:
##                 :...Education <= 16: No (21.6/4.3)
##                 :   Education > 16: Yes (6.2/1.1)
##                 ShelveLoc = Medium:
##                 :...Age <= 33: Yes (17.8/2)
##                     Age > 33:
##                     :...Population <= 303: No (41.7/9)
##                         Population > 303:
##                         :...Income <= 46: No (7.9/0.6)
##                             Income > 46: Yes (28.9/7)
##
## -----  Trial 20:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Age > 77: No (3.9)
## :   Age <= 77:
## :   :...Price <= 156: Yes (43.9/6.7)
## :       Price > 156: No (3.3)
## ShelveLoc in {Bad,Medium}:
## :...Education <= 10:
##     :...Age <= 72: Yes (23.8/2.9)
##     :   Age > 72: No (5.2)
##     Education > 10:
##     :...Price > 126:
##         :...Advertising <= 23: No (48.1/4.8)
##         :   Advertising > 23: Yes (3.5)
##         Price <= 126:
##         :...CompPrice > 123:
##             :...Advertising > 10: Yes (17.9)
##             :   Advertising <= 10:
##             :   :...Age > 75: No (4.1)
##             :       Age <= 75:
##             :       :...US = No: Yes (36.9/8.3)
```

```
##              :            US = Yes: No (7.6/2.5)
##            CompPrice <= 123:
##            :...Income > 115: Yes (6.8)
##                Income <= 115:
##                :...Price <= 70: Yes (5)
##                    Price > 70:
##                    :...Advertising <= 0: No (33/1.2)
##                        Advertising > 0:
##                        :...Age <= 63:
##                            :...Price <= 97: No (11.1/2.9)
##                            :   Price > 97: Yes (23.3/4.9)
##                            Age > 63:
##                            :...Price <= 89: Yes (4.1)
##                                Price > 89: No (19.6)
##
## -----  Trial 21:  -----
##
## Decision tree:
##
## Price <= 100:
## :...Advertising > 7: Yes (28.2/1.9)
## :   Advertising <= 7:
## :   :...Price > 97: Yes (9.1)
## :       Price <= 97:
## :       :...CompPrice > 124: Yes (8.9)
## :           CompPrice <= 124:
## :           :...Age <= 35: Yes (6.2)
## :               Age > 35:
## :               :...Income <= 102: No (21.6/2.4)
## :                   Income > 102: Yes (3.5)
## Price > 100:
## :...CompPrice > 139:
##     :...Price <= 156: Yes (43.3/8.6)
##     :   Price > 156: No (8.4/1.1)
##     CompPrice <= 139:
##     :...ShelveLoc = Good:
##         :...CompPrice > 129: Yes (7.8)
##         :   CompPrice <= 129:
##         :   :...Price <= 135: Yes (13.5/4.6)
##         :       Price > 135: No (9.4)
##         ShelveLoc in {Bad,Medium}:
##         :...Advertising <= 2: No (52.6/5.6)
##             Advertising > 2:
##             :...US = No: Yes (7.1/1.5)
##                 US = Yes:
##                 :...Income <= 27: Yes (7.2/1.2)
##                     Income > 27:
##                     :...Advertising <= 10: No (29/1.8)
##                         Advertising > 10:
##                         :...Age <= 52: Yes (17.1/4.8)
##                             Age > 52: No (28/7)
##
## -----  Trial 22:  -----
##
```

```
## Decision tree:
##
## Price <= 102:
## :...ShelveLoc = Good: Yes (8.8)
## :   ShelveLoc in {Bad,Medium}:
## :   :...Advertising > 11: Yes (12.3)
## :       Advertising <= 11:
## :       :...Advertising > 10: No (4.3)
## :           Advertising <= 10:
## :           :...Advertising > 7: Yes (13.4)
## :               Advertising <= 7:
## :               :...Price <= 70: Yes (8.2)
## :                   Price > 70:
## :                   :...CompPrice > 125: Yes (7.3)
## :                       CompPrice <= 125:
## :                       :...Urban = No: Yes (7.4/1.9)
## :                           Urban = Yes: No (22.9/5.7)
## Price > 102:
## :...CompPrice <= 121: No (64.3/10.7)
##     CompPrice > 121:
##     :...Advertising > 13: Yes (23.6/3.8)
##         Advertising <= 13:
##         :...ShelveLoc = Good: Yes (16.8/4)
##             ShelveLoc in {Bad,Medium}:
##             :...Price > 144: No (15.8)
##                 Price <= 144:
##                 :...ShelveLoc = Bad: No (33.5/6)
##                     ShelveLoc = Medium:
##                     :...Age <= 33: Yes (7.3)
##                         Age > 33:
##                         :...CompPrice > 142: Yes (15.8/3.4)
##                             CompPrice <= 142:
##                             :...Price <= 114: Yes (9.7/1.8)
##                                 Price > 114: No (29.3/5)
##
## -----  Trial 23:  -----
##
## Decision tree:
##
## Price > 135:
## :...CompPrice <= 136: No (23.4)
## :   CompPrice > 136:
## :   :...Advertising > 20: Yes (2.5)
## :       Advertising <= 20:
## :       :...Income <= 82: No (21.7/1.1)
## :           Income > 82: Yes (9.4/2.2)
## Price <= 135:
## :...ShelveLoc = Good:
##     :...CompPrice <= 98: No (5.6/0.9)
##     :   CompPrice > 98: Yes (32)
##     ShelveLoc in {Bad,Medium}:
##     :...Income > 100: Yes (26.9/2.5)
##         Income <= 100:
##         :...ShelveLoc = Bad:
```

```
##             :...Education > 17: Yes (5.9/1.3)
##             :    Education <= 17:
##             :    :...Price > 125: No (13.6)
##             :        Price <= 125:
##             :        :...CompPrice <= 131: No (26.1/6.8)
##             :             CompPrice > 131: Yes (10.2/1.3)
##          ShelveLoc = Medium:
##          :...Price <= 84: Yes (12.2)
##              Price > 84:
##              :...CompPrice > 139: Yes (8.5)
##                  CompPrice <= 139:
##                  :...Advertising <= 0: No (26.4/4.9)
##                      Advertising > 0:
##                      :...Age <= 40: Yes (17.7/5.1)
##                          Age > 40:
##                          :...Price > 127: No (9.4)
##                              Price <= 127:
##                              :...CompPrice > 123: Yes (23.4/5)
##                                  CompPrice <= 123:
##                                  :...Price <= 101: Yes (13.3/2.9)
##                                      Price > 101: No (12.7)
##
## -----  Trial 24:  -----
##
## Decision tree:
##
## Price <= 104:
## :...ShelveLoc = Good: Yes (11.7)
## :    ShelveLoc in {Bad,Medium}:
## :    :...Age > 67: No (16.6/4.7)
## :        Age <= 67:
## :        :...CompPrice > 118: Yes (24)
## :            CompPrice <= 118:
## :            :...Income <= 53: No (8.4/1.4)
## :                Income > 53: Yes (37.5/6.7)
## Price > 104:
## :...ShelveLoc = Good:
##     :...Income <= 43: No (15.8/3.5)
##     :    Income > 43: Yes (22.7/2.7)
##     ShelveLoc in {Bad,Medium}:
##     :...CompPrice <= 114: No (19.8)
##         CompPrice > 114:
##         :...Price > 135: No (32.7/4.2)
##             Price <= 135:
##             :...Advertising > 10:
##                 :...Price <= 126: Yes (21.6/2.3)
##                 :    Price > 126: No (11.9/3.7)
##                 Advertising <= 10:
##                 :...CompPrice > 143: Yes (11.6/2.2)
##                     CompPrice <= 143:
##                     :...ShelveLoc = Bad: No (19.3)
##                         ShelveLoc = Medium:
##                         :...Age <= 49: Yes (18.3/6.1)
##                             Age > 49: No (29.1/3.2)
```

```
##
## -----  Trial 25:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 135: Yes (34.4/2.9)
## :    Price > 135: No (17.4/4.8)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 104:
##     :...CompPrice > 118: Yes (26.1/1.1)
##     :    CompPrice <= 118:
##     :    :...Income > 100: Yes (8.5)
##     :        Income <= 100:
##     :        :...Price <= 80: Yes (11.4/1.1)
##     :            Price > 80:
##     :            :...US = No: No (13.2)
##     :                US = Yes:
##     :                :...Population <= 256: Yes (17.1/4.4)
##     :                    Population > 256: No (11.9/0.6)
##     Price > 104:
##     :...Advertising > 21: Yes (10)
##         Advertising <= 21:
##         :...CompPrice <= 115: No (20)
##             CompPrice > 115:
##             :...Price > 144: No (13.2)
##                 Price <= 144:
##                 :...CompPrice > 142:
##                     :...CompPrice <= 159: Yes (20.8/3.7)
##                     :    CompPrice > 159: No (3.8)
##                     CompPrice <= 142:
##                     :...ShelveLoc = Bad: No (22.3/2.3)
##                         ShelveLoc = Medium:
##                         :...Age <= 33: Yes (9)
##                             Age > 33:
##                             :...Price > 127: No (11.4)
##                                 Price <= 127:
##                                 :...Advertising <= 3: No (23.4/3.2)
##                                     Advertising > 3:
##                                     :...CompPrice <= 129: No (19.9/7.3)
##                                         CompPrice > 129: Yes (7.1)
##
## -----  Trial 26:  -----
##
## Decision tree:
##
## Advertising <= 7:
## :...ShelveLoc = Bad: No (35.1/6.9)
## :    ShelveLoc = Good:
## :    :...Urban = No: No (11.4/2.4)
## :    :    Urban = Yes: Yes (20.8/3.8)
## :    ShelveLoc = Medium:
## :    :...Population <= 203: No (47.7/9.5)
## :        Population > 203:
```

```
## :          :...Urban = No: Yes (19.3/4.9)
## :              Urban = Yes:
## :              :...Population <= 284: Yes (10.3/1.7)
## :                  Population > 284: No (21.1/6.6)
## Advertising > 7:
## :...ShelveLoc = Good: Yes (23.1/2.1)
##     ShelveLoc in {Bad,Medium}:
##     :...Price <= 126:
##         :...Income > 97: Yes (22)
##         :   Income <= 97:
##         :   :...Income <= 91: Yes (53.8/13.7)
##         :       Income > 91: No (5.4)
##         Price > 126:
##         :...Advertising > 23: Yes (6.2)
##             Advertising <= 23:
##             :...Education <= 10: Yes (5.4/0.6)
##                 Education > 10: No (19.5/0.7)
##
## -----  Trial 27:  -----
##
## Decision tree:
##
## Price <= 86: Yes (24.3/3.5)
## Price > 86:
## :...Age > 73: No (33.1/6.8)
##     Age <= 73:
##     :...CompPrice <= 103: No (14.7/1.2)
##         CompPrice > 103:
##         :...ShelveLoc = Good: Yes (40.4/6.7)
##             ShelveLoc in {Bad,Medium}:
##             :...Education <= 10: Yes (19.2/3.6)
##                 Education > 10:
##                 :...Price > 126:
##                     :...Advertising <= 22: No (37.3/4)
##                     :   Advertising > 22: Yes (5)
##                     Price <= 126:
##                     :...CompPrice > 123:
##                         :...Population > 289: Yes (20.6/0.1)
##                         :   Population <= 289:
##                         :   :...Urban = No: No (13.6/3.8)
##                         :       Urban = Yes: Yes (28.5/6.2)
##                         CompPrice <= 123:
##                         :...Income > 115: Yes (5.9)
##                             Income <= 115:
##                             :...Advertising <= 0: No (21.8/1.5)
##                                 Advertising > 0:
##                                 :...Price <= 102: Yes (15.4/2.9)
##                                     Price > 102: No (21.1/5.5)
##
## -----  Trial 28:  -----
##
## Decision tree:
##
## Advertising <= 7:
```

```
## :...Population > 492: Yes (11.3/0.6)
## :    Population <= 492:
## :    :...ShelveLoc = Bad:
## :         :...CompPrice <= 139: No (33/3.6)
## :         :    CompPrice > 139: Yes (9.6/3)
## :         ShelveLoc = Good:
## :         :...Education <= 11: Yes (5.7)
## :         :    Education > 11:
## :         :    :...Education <= 16: No (21.1/5.6)
## :         :         Education > 16: Yes (5)
## :         ShelveLoc = Medium:
## :         :...Price <= 84: Yes (6.7)
## :             Price > 84:
## :             :...Population > 435: No (10.3)
## :                  Population <= 435:
## :                  :...Age <= 33: Yes (16.1/3.9)
## :                      Age > 33: No (60.9/19.2)
## Advertising > 7:
## :...ShelveLoc = Good: Yes (22.2/4.4)
##     ShelveLoc = Bad:
##     :...Price > 125: No (8.3)
##     :    Price <= 125:
##     :    :...CompPrice <= 119: No (11/3.6)
##     :         CompPrice > 119: Yes (12.4)
##     ShelveLoc = Medium:
##     :...US = No: Yes (2.8)
##         US = Yes:
##         :...Price <= 105: Yes (18.1/1.1)
##             Price > 105:
##             :...CompPrice <= 114: No (8.1)
##                  CompPrice > 114:
##                  :...Advertising <= 10: No (4.5/0.3)
##                      Advertising > 10: Yes (34.1/8.6)
##
## -----  Trial 29:  -----
##
## Decision tree:
##
## Price > 129:
## :...CompPrice <= 136: No (37.9/2.7)
## :    CompPrice > 136:
## :    :...ShelveLoc = Bad: No (5.9)
## :         ShelveLoc in {Good,Medium}:
## :         :...Price <= 156: Yes (25.7/5.6)
## :             Price > 156: No (8.4/1.2)
## Price <= 129:
## :...ShelveLoc = Good: Yes (30.6/2.6)
##     ShelveLoc in {Bad,Medium}:
##     :...Income > 100:
##         :...Population <= 125: No (4/0.5)
##         :    Population > 125: Yes (26.6/0.5)
##         Income <= 100:
##         :...CompPrice <= 122:
##             :...Price <= 70: Yes (6.3)
```

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```
##                   :    Price > 70:
##                   :    :...US = No: No (20.6/2.2)
##                   :        US = Yes:
##                   :        :...Age <= 35: Yes (10.3/2.7)
##                   :            Age > 35: No (42.9/9.9)
##               CompPrice > 122:
##               :...Price <= 104: Yes (22.8/1.4)
##                   Price > 104:
##                   :...Advertising > 10: Yes (16.1/1.6)
##                       Advertising <= 10:
##                       :...CompPrice <= 143: No (31.8/7.2)
##                           CompPrice > 143: Yes (11.1/2.7)
##
## -----  Trial 30:  -----
##
## Decision tree:
##
## Price <= 104:
## :...ShelveLoc in {Good,Medium}: Yes (69.4/12)
## :    ShelveLoc = Bad:
## :    :...Income <= 95: No (20.6/6.5)
## :        Income > 95: Yes (10.4)
## Price > 104:
## :...ShelveLoc = Bad: No (38.7/8.4)
##     ShelveLoc in {Good,Medium}:
##     :...Income <= 61:
##         :...Urban = No: No (27/0.7)
##         :    Urban = Yes:
##         :    :...Price > 141: No (10.1)
##         :        Price <= 141:
##         :        :...ShelveLoc = Good: Yes (7)
##         :            ShelveLoc = Medium:
##         :            :...Advertising <= 3: No (8.4/0.4)
##         :                Advertising > 3: Yes (21.9/7.4)
##         Income > 61:
##         :...ShelveLoc = Good: Yes (21.4/3.5)
##             ShelveLoc = Medium:
##             :...Income <= 66: Yes (12.7/0.6)
##                 Income > 66:
##                 :...Income <= 75: No (13.8)
##                     Income > 75:
##                     :...Population <= 140: No (15.8/5.2)
##                         Population > 140: Yes (23.8/4.5)
##
## -----  Trial 31:  -----
##
## Decision tree:
##
## Price > 126:
## :...Advertising > 22: Yes (5.3)
## :    Advertising <= 22:
## :    :...ShelveLoc in {Bad,Medium}: No (65.3/11.6)
## :        ShelveLoc = Good:
## :        :...Price <= 135: Yes (6.4)
```

```
## :             Price > 135: No (19.2/5.1)
## Price <= 126:
## :...CompPrice <= 123:
##     :...Price > 103: No (50.3/11.7)
##     :   Price <= 103:
##     :   :...Advertising > 7: Yes (28.5/2.1)
##     :       Advertising <= 7:
##     :       :...Price <= 70: Yes (9.1)
##     :           Price > 70:
##     :           :...Education <= 11: Yes (18.5/7.6)
##     :               Education > 11: No (25.2/3.1)
##     CompPrice > 123:
##     :...Advertising > 10: Yes (18.2)
##         Advertising <= 10:
##         :...Price <= 105: Yes (16)
##             Price > 105:
##             :...ShelveLoc = Bad: No (6.8/2.1)
##                 ShelveLoc = Good: Yes (5)
##                 ShelveLoc = Medium:
##                 :...US = No: Yes (23.6/5.1)
##                     US = Yes: No (3.5)
##
## -----  Trial 32:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Age > 77: No (3.5)
## :   Age <= 77:
## :   :...Price <= 156: Yes (45.6/7)
## :       Price > 156: No (3.4)
## ShelveLoc in {Bad,Medium}:
## :...CompPrice > 143: Yes (35.9/9.4)
##     CompPrice <= 143:
##     :...Price > 125: No (41.1/6.1)
##         Price <= 125:
##         :...Age <= 49:
##             :...Advertising > 16: Yes (10.9)
##             :   Advertising <= 16:
##             :   :...Price <= 117: Yes (41.4/8.4)
##             :       Price > 117: No (18/5.9)
##             Age > 49:
##             :...Income > 111: Yes (7.5)
##                 Income <= 111:
##                 :...Price <= 86: Yes (7.3/0.8)
##                     Price > 86:
##                     :...Age <= 55: No (11.3)
##                         Age > 55:
##                         :...CompPrice > 123: Yes (20.6/7.6)
##                             CompPrice <= 123:
##                             :...Price > 102: No (19.6)
##                                 Price <= 102:
##                                 :...Advertising <= 11: No (30.9/8.6)
##                                     Advertising > 11: Yes (3.8)
```

```
## 
## -----  Trial 33:  -----
## 
## Decision tree:
## 
## Age > 76: No (23.6/3.2)
## Age <= 76:
## :...Advertising > 7:
##     :...Price <= 126:
##     :   :...ShelveLoc = Good: Yes (7.4)
##     :   :    ShelveLoc in {Bad,Medium}:
##     :   :    :...Age <= 70: Yes (52.8/10.5)
##     :   :        Age > 70: No (4.9)
##     :   Price > 126:
##     :   :...ShelveLoc = Bad: No (5.7)
##     :        ShelveLoc in {Good,Medium}:
##     :        :...Age <= 41: Yes (9.7)
##     :            Age > 41:
##     :            :...Population <= 279: No (10.6)
##     :                Population > 279: Yes (16.4/4.2)
##     Advertising <= 7:
##     :...Price <= 100:
##         :...Price > 97: Yes (12.8)
##         :   Price <= 97:
##         :   :...Urban = No: Yes (11.4/2.8)
##         :        Urban = Yes:
##         :        :...CompPrice <= 121: No (21.9/6.4)
##         :            CompPrice > 121: Yes (5.2)
##         Price > 100:
##         :...CompPrice <= 115: No (27.2/1.6)
##             CompPrice > 115:
##             :...ShelveLoc = Good: Yes (13.2/1.9)
##                 ShelveLoc in {Bad,Medium}:
##                 :...US = Yes: No (29.3/7.3)
##                     US = No:
##                     :...Advertising <= 2: No (38.1/12)
##                         Advertising > 2: Yes (10.7/1.9)
## 
## -----  Trial 34:  -----
## 
## Decision tree:
## 
## Price <= 100:
## :...Income <= 25: No (4.3)
## :   Income > 25:
## :   :...ShelveLoc in {Good,Medium}: Yes (45.9/7.3)
## :        ShelveLoc = Bad:
## :        :...Income <= 50: No (8.2/0.8)
## :            Income > 50: Yes (16/2.8)
## Price > 100:
## :...Age > 60:
##     :...Advertising <= 3: No (25.6/2.8)
##     :   Advertising > 3:
##     :   :...US = No: Yes (6.1/0.1)
```

```
##      :          US = Yes: No (38.7/8.9)
##      Age <= 60:
##      :...Price > 139: No (22.2/3.6)
##          Price <= 139:
##          :...CompPrice > 133:
##              :...CompPrice <= 159: Yes (39.7/4.7)
##              :   CompPrice > 159: No (3.1)
##              CompPrice <= 133:
##              :...Income <= 61:
##                  :...Advertising <= 20: No (41.5/6.7)
##                  :   Advertising > 20: Yes (3.1)
##                  Income > 61:
##                  :...Education <= 17: Yes (40.9/8.1)
##                      Education > 17: No (5.6/0.9)
##
## -----  Trial 35:  -----
##
## Decision tree:
##
## ShelveLoc = Good: Yes (55.5/11.9)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 80: Yes (14.6/1.7)
##     Price > 80:
##     :...CompPrice <= 121:
##         :...US = No: No (29.9/3.4)
##         :   US = Yes:
##         :   :...Price > 116: No (20.4/1.8)
##         :       Price <= 116:
##         :       :...Age <= 49: Yes (10.7)
##         :           Age > 49:
##         :           :...Education <= 16: No (24.4/5)
##         :               Education > 16: Yes (6.6/0.4)
##         CompPrice > 121:
##         :...Advertising > 13: Yes (26.5/3.8)
##             Advertising <= 13:
##             :...Price <= 104: Yes (15.1/2.1)
##                 Price > 104:
##                 :...Price > 144: No (9.3)
##                     Price <= 144:
##                     :...CompPrice > 147: Yes (20.9/4.8)
##                         CompPrice <= 147:
##                         :...ShelveLoc = Bad: No (22.2/1.9)
##                             ShelveLoc = Medium:
##                             :...Age <= 33: Yes (6.5)
##                                 Age > 33:
##                                 :...CompPrice <= 142: No (35.8/9.1)
##                                     CompPrice > 142: Yes (2.5)
##
## -----  Trial 36:  -----
##
## Decision tree:
##
## Price > 126:
## :...Advertising > 22: Yes (6.8)
```

```
## :    Advertising <= 22:
## :    :...Population <= 112: Yes (9.1/2.5)
## :         Population > 112: No (85.1/17)
## Price <= 126:
## :...Age > 75: No (21.2/5)
##     Age <= 75:
##     :...Income > 100: Yes (31.3/1.8)
##         Income <= 100:
##         :...CompPrice > 123: Yes (60.6/12.4)
##             CompPrice <= 123:
##             :...ShelveLoc = Bad: No (18.1/3.8)
##                 ShelveLoc = Good: Yes (14.2/3.9)
##                 ShelveLoc = Medium:
##                 :...Price <= 84: Yes (5.5)
##                     Price > 84:
##                     :...CompPrice <= 111: No (16.8/2.6)
##                         CompPrice > 111:
##                         :...Education > 16: Yes (3.8)
##                             Education <= 16:
##                             :...Income <= 46: No (9.4/0.7)
##                                 Income > 46: Yes (19.2/6.5)
##
## -----  Trial 37:  -----
##
## Decision tree:
##
## Advertising <= 7:
## :...Age > 76: No (15.7)
## :    Age <= 76:
## :    :...Price <= 70: Yes (8.4)
## :        Price > 70:
## :        :...ShelveLoc = Bad: No (38/8.4)
## :            ShelveLoc in {Good,Medium}:
## :            :...Population > 198:
## :                :...Price <= 145: Yes (55.7/15)
## :                :   Price > 145: No (6.9)
## :                Population <= 198:
## :                :...CompPrice <= 129: No (26/0.9)
## :                    CompPrice > 129:
## :                    :...ShelveLoc = Good: Yes (5.1)
## :                        ShelveLoc = Medium: No (19.3/6.5)
## Advertising > 7:
## :...Price <= 109: Yes (35.4/3.8)
##     Price > 109:
##     :...Urban = No: No (18.6/5)
##         Urban = Yes:
##         :...Education <= 10: Yes (12.6/0.3)
##             Education > 10:
##             :...ShelveLoc = Good: Yes (14.3/1.7)
##                 ShelveLoc in {Bad,Medium}:
##                 :...Advertising > 21: Yes (5.8)
##                     Advertising <= 21:
##                     :...Price <= 126: Yes (19.3/6.6)
##                         Price > 126: No (19.9/1.8)
```

```
##
## -----  Trial 38:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Income <= 42: No (20.3/6.3)
## :    Income > 42: Yes (34.3/4)
## ShelveLoc in {Bad,Medium}:
## :...Education <= 10: Yes (24.3/6.7)
##     Education > 10:
##     :...Price > 125:
##         :...Advertising <= 23: No (58.6/9.4)
##         :    Advertising > 23: Yes (4.3)
##         Price <= 125:
##         :...CompPrice > 131: Yes (35.3/8.8)
##             CompPrice <= 131:
##             :...Income > 100: Yes (16.5/3.3)
##                 Income <= 100:
##                 :...Population > 492: Yes (9.7/1.5)
##                     Population <= 492:
##                     :...US = No:
##                         :...Price <= 72: Yes (3)
##                         :    Price > 72: No (28.6/0.5)
##                         US = Yes:
##                         :...CompPrice <= 99: No (9.7)
##                             CompPrice > 99:
##                             :...Price <= 92: Yes (6.5)
##                                 Price > 92:
##                                 :...ShelveLoc = Bad: No (11.5/1.8)
##                                     ShelveLoc = Medium:
##                                     :...Age <= 48: Yes (8.9/1.2)
##                                         Age > 48: No (29.4/8.9)
##
## -----  Trial 39:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 135: Yes (38.5/3)
## :    Price > 135: No (19.8/5.7)
## ShelveLoc in {Bad,Medium}:
## :...CompPrice > 143: Yes (30.7/7.9)
##     CompPrice <= 143:
##     :...Price > 102:
##         :...Advertising <= 10: No (95.6/13)
##         :    Advertising > 10:
##         :    :...Age <= 44: Yes (16.2/2.4)
##         :        Age > 44: No (37.8/12.5)
##         Price <= 102:
##         :...CompPrice > 123: Yes (10.9)
##             CompPrice <= 123:
##             :...Advertising > 7: Yes (15.3/2.2)
##                 Advertising <= 7:
```

```
##                  :...Urban = No: Yes (8.7/1.6)
##                     Urban = Yes:
##                     :...Price <= 70: Yes (3.4)
##                         Price > 70: No (24.1/6.3)
##
## -----  Trial 40:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price > 156: No (4.2)
## :    Price <= 156:
## :    :...Age <= 76: Yes (48/8.3)
## :        Age > 76: No (3.1)
## ShelveLoc in {Bad,Medium}:
## :...Price > 126:
##     :...CompPrice <= 142: No (38/2.9)
##     :    CompPrice > 142:
##     :    :...Education <= 17: No (23.6/7)
##     :        Education > 17: Yes (6.3/0.7)
##     Price <= 126:
##     :...CompPrice > 123:
##         :...Advertising > 10: Yes (25.5)
##         :    Advertising <= 10:
##         :    :...Age > 74: No (6.1)
##         :        Age <= 74:
##         :        :...Price <= 105: Yes (11.2)
##         :            Price > 105:
##         :            :...US = Yes: No (5)
##         :                US = No:
##         :                :...Education <= 16: Yes (26.4/6.6)
##         :                    Education > 16: No (4.8/0.3)
##         CompPrice <= 123:
##         :...Income > 115: Yes (5.7)
##             Income <= 115:
##             :...Price > 102: No (43.4/5.6)
##                 Price <= 102:
##                 :...Age > 68: No (11.9/1.2)
##                     Age <= 68:
##                     :...Advertising > 7: Yes (8.5)
##                         Advertising <= 7:
##                         :...Age <= 35: Yes (6)
##                             Age > 35:
##                             :...Education <= 13: Yes (14.3/3.6)
##                                 Education > 13: No (9/0.8)
##
## -----  Trial 41:  -----
##
## Decision tree:
##
## ShelveLoc = Bad:
## :...Education > 17: Yes (3.7/0.4)
## :    Education <= 17:
## :    :...Price > 125: No (15.6)
```

```
## :          Price <= 125:
## :          :...Advertising > 18: Yes (3.5)
## :               Advertising <= 18:
## :               :...Population <= 95: No (8.3)
## :                    Population > 95:
## :                    :...CompPrice <= 129: No (29.9/8.4)
## :                         CompPrice > 129: Yes (4.9)
## ShelveLoc in {Good,Medium}:
## :...Advertising <= 7:
##     :...Age > 76: No (10.1)
##     :   Age <= 76:
##     :   :...CompPrice <= 115:
##     :        :...Price <= 100: Yes (17.1/3)
##     :        :   Price > 100: No (24.9/0.5)
##     :        CompPrice > 115:
##     :        :...Age <= 33: Yes (22/2.4)
##     :             Age > 33:
##     :             :...ShelveLoc = Good: Yes (9.5/1)
##     :                  ShelveLoc = Medium:
##     :                  :...US = Yes: No (18/2.6)
##     :                       US = No:
##     :                       :...Advertising <= 2: No (26.9/8.6)
##     :                            Advertising > 2: Yes (8.9/1)
##     Advertising > 7:
##     :...US = No: Yes (4.7)
##         US = Yes:
##         :...Advertising > 21: Yes (8.6)
##              Advertising <= 21:
##              :...Price > 136: No (12.2/3.9)
##                   Price <= 136:
##                   :...ShelveLoc = Good: Yes (12.3)
##                        ShelveLoc = Medium:
##                        :...Education <= 10: Yes (15.3)
##                             Education > 10:
##                             :...Price <= 126: Yes (39.4/10.2)
##                                  Price > 126: No (5.4)
##
## -----  Trial 42:  -----
##
## Decision tree:
##
## Price <= 86: Yes (24.7/2.3)
## Price > 86:
## :...CompPrice <= 99: No (15.5/0.2)
##     CompPrice > 99:
##     :...ShelveLoc = Bad:
##         :...Income <= 98: No (42.5/9.8)
##         :   Income > 98: Yes (9.9/2.1)
##         ShelveLoc in {Good,Medium}:
##         :...Population <= 139: No (50.8/16.4)
##              Population > 139:
##              :...Income > 74: Yes (58.7/7.4)
##                   Income <= 74:
##                   :...Price > 135: No (24.6/5)
```

```
##                      Price <= 135:
##                      :...ShelveLoc = Good: Yes (8.4)
##                          ShelveLoc = Medium:
##                          :...Income > 68: No (8.5/0.1)
##                              Income <= 68:
##                              :...CompPrice > 133: Yes (12)
##                                  CompPrice <= 133:
##                                  :...Income > 61: Yes (7.3)
##                                      Income <= 61:
##                                      :...Price <= 100: Yes (6.6)
##                                          Price > 100: No (31.8/10.7)
##
## -----  Trial 43:  -----
##
## Decision tree:
##
## Price <= 105:
## :...CompPrice > 123: Yes (28.5)
## :   CompPrice <= 123:
## :   :...ShelveLoc = Good: Yes (6.3)
## :       ShelveLoc in {Bad,Medium}:
## :       :...Income <= 48: No (15.6/1.2)
## :           Income > 48:
## :           :...Urban = No: Yes (14.5)
## :               Urban = Yes:
## :               :...Price <= 86: Yes (10.8)
## :                   Price > 86:
## :                   :...US = No: No (3.7)
## :                       US = Yes:
## :                       :...CompPrice <= 103: No (5.2)
## :                           CompPrice > 103: Yes (18.2/5.8)
## Price > 105:
## :...CompPrice <= 114: No (31.6/4.4)
##     CompPrice > 114:
##     :...ShelveLoc = Bad:
##         :...Urban = No: No (4.5)
##         :   Urban = Yes:
##         :   :...Education > 16: Yes (4.8/0.2)
##         :       Education <= 16:
##         :       :...Population <= 396: No (17.8/0.1)
##         :           Population > 396: Yes (7.4/2.5)
##         ShelveLoc in {Good,Medium}:
##         :...ShelveLoc = Good:
##             :...Price <= 156: Yes (23.5/1.5)
##             :   Price > 156: No (4.5)
##             ShelveLoc = Medium:
##             :...Age <= 33:
##                 :...Price <= 144: Yes (19.9/0.5)
##                 :   Price > 144: No (2.2)
##                 Age > 33:
##                 :...Advertising <= 7: No (43.8/13)
##                     Advertising > 7:
##                     :...Urban = No: No (5.2/1.5)
##                         Urban = Yes:
```

```
##                          :...CompPrice <= 123: No (4.8)
##                               CompPrice > 123: Yes (28.1/3.7)
##
## -----  Trial 44:  -----
##
## Decision tree:
##
## Price > 144:
## :...Advertising <= 23: No (38.6/5.4)
## :   Advertising > 23: Yes (3.4)
## Price <= 144:
## :...CompPrice > 143: Yes (34.4/3.3)
##     CompPrice <= 143:
##     :...ShelveLoc = Good: Yes (35.8/6.5)
##         ShelveLoc in {Bad,Medium}:
##         :...Price > 125: No (34/4.8)
##             Price <= 125:
##             :...CompPrice > 121:
##                 :...Advertising > 3: Yes (34.6/2)
##                 :   Advertising <= 3:
##                 :   :...ShelveLoc = Bad: No (13.6/3.3)
##                 :       ShelveLoc = Medium: Yes (22.6/7)
##                 CompPrice <= 121:
##                 :...Age > 68: No (15.9/0.4)
##                     Age <= 68:
##                     :...Price > 115: No (10.5)
##                         Price <= 115:
##                         :...Urban = No: Yes (16.8/2.9)
##                             Urban = Yes:
##                             :...Age <= 35: Yes (6.5)
##                                 Age > 35:
##                                 :...Advertising <= 9: No (26.1/7.3)
##                                     Advertising > 9: Yes (8.2/1.5)
##
## -----  Trial 45:  -----
##
## Decision tree:
##
## Price <= 100:
## :...Income <= 25: No (4.2)
## :   Income > 25: Yes (66.2/13.3)
## Price > 100:
## :...CompPrice > 143: Yes (44.7/12.6)
##     CompPrice <= 143:
##     :...Advertising <= 9:
##         :...Age > 74: No (18)
##         :   Age <= 74:
##         :   :...Price > 130: No (13.4)
##         :       Price <= 130:
##         :       :...CompPrice <= 109: No (7.3)
##         :           CompPrice > 109:
##         :           :...ShelveLoc = Good: Yes (5)
##         :               ShelveLoc = Bad: No (9.8)
##         :               ShelveLoc = Medium:
```

```
##           :                 :...Income <= 95: No (32.9/8.2)
##           :                     Income > 95: Yes (7.2/1)
##         Advertising > 9:
##         :...ShelveLoc = Good: Yes (20.6/2.8)
##             ShelveLoc in {Bad,Medium}:
##             :...Advertising > 21: Yes (5.7)
##                 Advertising <= 21:
##                 :...Price > 135: No (13.2)
##                     Price <= 135:
##                     :...Income > 98: Yes (8.6/0.7)
##                         Income <= 98:
##                         :...Population <= 239: Yes (18/5.6)
##                             Population > 239: No (26.1/5.8)
##
## -----  Trial 46:  -----
##
## Decision tree:
##
## Age > 73:
## :...Price <= 84: Yes (2.5)
## :   Price > 84: No (36.9/4.9)
## Age <= 73:
## :...ShelveLoc = Good:
##     :...Urban = No: No (12.5/3.8)
##     :   Urban = Yes:
##     :   :...Price <= 156: Yes (23)
##     :       Price > 156: No (3.2)
##     ShelveLoc = Bad:
##     :...Price > 129: No (11.5)
##     :   Price <= 129:
##     :   :...Advertising > 10: Yes (6.7/0.3)
##     :       Advertising <= 10:
##     :       :...Education <= 10: Yes (3.6)
##     :           Education > 10: No (37.7/10.7)
##     ShelveLoc = Medium:
##     :...Education <= 10: Yes (13.6/1)
##         Education > 10:
##         :...Price > 127:
##             :...Advertising <= 22: No (33.3/1.5)
##             :   Advertising > 22: Yes (5.2)
##             Price <= 127:
##             :...Price <= 86: Yes (8.8)
##                 Price > 86:
##                 :...CompPrice <= 115: No (35.3/7.8)
##                     CompPrice > 115:
##                     :...CompPrice > 141: Yes (9.3)
##                         CompPrice <= 141:
##                         :...Urban = No: Yes (22.9/6.6)
##                             Urban = Yes:
##                             :...Income <= 80: Yes (24/6)
##                                 Income > 80: No (10.9/2.2)
##
## -----  Trial 47:  -----
##
```

```
## Decision tree:
##
## ShelveLoc = Good:
## :...Income <= 42: No (17.8/6)
## :    Income > 42: Yes (34.2/2.4)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 104:
##     :...CompPrice > 123: Yes (18.8)
##     :   CompPrice <= 123:
##     :   :...Income > 100: Yes (13.7)
##     :       Income <= 100:
##     :       :...Age <= 35: Yes (8.8)
##     :           Age > 35:
##     :           :...Price <= 70: Yes (4.2)
##     :               Price > 70:
##     :               :...US = No: No (13.4/0.8)
##     :                   US = Yes:
##     :                   :...Population <= 272: Yes (18.9/6.1)
##     :                       Population > 272: No (14.9)
##     Price > 104:
##     :...CompPrice <= 114: No (14.3)
##         CompPrice > 114:
##         :...Advertising > 15: Yes (16.9/3.7)
##             Advertising <= 15:
##             :...Price > 144: No (18)
##                 Price <= 144:
##                 :...CompPrice > 147: Yes (20.5/5.8)
##                     CompPrice <= 147:
##                     :...Population > 472: Yes (9/1.1)
##                         Population <= 472:
##                         :...Age <= 32: Yes (9.4/1.9)
##                             Age > 32: No (68.1/13.9)
##
## -----  Trial 48:  -----
##
## Decision tree:
##
## Price > 135:
## :...CompPrice <= 136: No (23.1)
## :   CompPrice > 136:
## :   :...Income <= 75: No (17/2.1)
## :       Income > 75: Yes (11.1/3)
## Price <= 135:
## :...ShelveLoc = Good: Yes (40.2/2.1)
##     ShelveLoc in {Bad,Medium}:
##     :...ShelveLoc = Bad:
##         :...CompPrice <= 94: Yes (3.9)
##         :   CompPrice > 94:
##         :   :...CompPrice <= 118: No (17.7/1.4)
##         :       CompPrice > 118:
##         :       :...Price <= 92: Yes (7.9)
##         :           Price > 92:
##         :           :...US = No: No (8.1/1.5)
##         :               US = Yes:
```

```
##            :                  :...Population <= 279: Yes (10.9/3)
##            :                    Population > 279: No (12.2/1.6)
##          ShelveLoc = Medium:
##          :...CompPrice > 140: Yes (12.4)
##              CompPrice <= 140:
##              :...Price <= 86: Yes (7.5)
##                  Price > 86:
##                  :...Advertising > 11:
##                      :...Age <= 56: Yes (21.2/1.9)
##                      :   Age > 56: No (17.8/7.3)
##                      Advertising <= 11:
##                      :...Age > 74: No (8.5)
##                          Age <= 74:
##                          :...Age > 71: Yes (6.5)
##                              Age <= 71:
##                              :...Population > 492: Yes (6.6/0.2)
##                                  Population <= 492:
##                                  :...Income <= 62: No (31.9/4.8)
##                                      Income > 62:
##                                      :...CompPrice <= 102: No (4.3)
##                                          CompPrice > 102: Yes (32.4/13.1)
##
## -----  Trial 49:  -----
##
## Decision tree:
##
## ShelveLoc = Good: Yes (49/12.7)
## ShelveLoc in {Bad,Medium}:
## :...Price > 126:
##     :...Advertising <= 23: No (61.1/8.2)
##     :   Advertising > 23: Yes (3.9)
##     Price <= 126:
##     :...CompPrice > 123:
##         :...Advertising > 10: Yes (28.1)
##         :   Advertising <= 10:
##         :   :...Price <= 105: Yes (15.3)
##         :       Price > 105:
##         :       :...US = Yes: No (8.9)
##         :           US = No:
##         :           :...Education <= 16: Yes (22.4/5.8)
##         :               Education > 16: No (6.1/0.3)
##         CompPrice <= 123:
##         :...Income > 115: Yes (6.6)
##             Income <= 115:
##             :...Age > 68: No (19/0.8)
##                 Age <= 68:
##                 :...Urban = No: Yes (21.3/8.1)
##                     Urban = Yes:
##                     :...CompPrice > 116: No (21.1/2.4)
##                         CompPrice <= 116:
##                         :...CompPrice > 115: Yes (5.5)
##                             CompPrice <= 115:
##                             :...Price > 103: No (9.3)
##                                 Price <= 103:
```

```
##                                              :...Advertising <= 8: No (16.5/5.9)
##                                                  Advertising > 8: Yes (6.8)
##
## -----  Trial 50:  -----
##
## Decision tree:
##
## Price <= 100:
## :...ShelveLoc = Good: Yes (8.1)
## :   ShelveLoc in {Bad,Medium}:
## :   :...Price > 97: Yes (10.6)
## :       Price <= 97:
## :       :...Price <= 70: Yes (10)
## :           Price > 70:
## :           :...Advertising > 7: Yes (12.7/0.9)
## :               Advertising <= 7:
## :               :...CompPrice <= 125: No (21.8/4.2)
## :                   CompPrice > 125: Yes (7.3)
## Price > 100:
## :...Advertising <= 2:
##     :...CompPrice <= 147: No (76.5/10.4)
##     :   CompPrice > 147: Yes (10.8/3.4)
##     Advertising > 2:
##     :...US = No: Yes (12.1/2.1)
##         US = Yes:
##         :...Price <= 115:
##             :...Price > 111: Yes (11)
##             :   Price <= 111:
##             :   :...Advertising <= 9: No (3.3)
##             :       Advertising > 9:
##             :       :...Age <= 70: Yes (20.9/3.8)
##             :           Age > 70: No (4.8/0.6)
##             Price > 115:
##             :...Advertising > 21: Yes (5.8)
##                 Advertising <= 21:
##                 :...Urban = No: No (19.1/2.7)
##                     Urban = Yes:
##                     :...Education <= 10: Yes (11.2/1.2)
##                         Education > 10: No (55.1/17.9)
##
## -----  Trial 51:  -----
##
## Decision tree:
##
## Price > 135: No (52.6/12.7)
## Price <= 135:
## :...ShelveLoc = Good: Yes (44.9/3.6)
##     ShelveLoc in {Bad,Medium}:
##     :...CompPrice > 142: Yes (23.4/3)
##         CompPrice <= 142:
##         :...Price <= 100:
##             :...Income <= 26: No (3.3)
##             :   Income > 26: Yes (53.2/13.6)
##             Price > 100:
```

```
##               :...Advertising <= 10: No (74.6/15.1)
##                  Advertising > 10:
##                  :...CompPrice <= 121: No (19.2/5.5)
##                      CompPrice > 121: Yes (29.9/2.5)
##
## -----  Trial 52:  -----
##
## Decision tree:
##
## ShelveLoc = Bad:
## :...Income > 98: Yes (11.8/2.4)
## :    Income <= 98:
## :    :...Urban = No: No (11.1/0.7)
## :        Urban = Yes:
## :        :...Education <= 17: No (45/10.5)
## :             Education > 17: Yes (3.1)
## ShelveLoc in {Good,Medium}:
## :...Price <= 86: Yes (11.7)
##     Price > 86:
##     :...CompPrice <= 99: No (11.4/0.5)
##         CompPrice > 99:
##         :...Age > 76: No (13.6/2.1)
##             Age <= 76:
##             :...ShelveLoc = Good: Yes (50.2/8.2)
##                 ShelveLoc = Medium:
##                 :...Age <= 38: Yes (36.3/8)
##                     Age > 38:
##                     :...Urban = No:
##                         :...Income <= 70: No (20.9/6.7)
##                         :   Income > 70: Yes (17/1.5)
##                         Urban = Yes:
##                         :...CompPrice <= 123: No (28.3/5.6)
##                             CompPrice > 123:
##                             :...Education <= 12: Yes (19.1/2.2)
##                                 Education > 12: No (21.6/7.7)
##
## -----  Trial 53:  -----
##
## Decision tree:
##
## Price > 126:
## :...Advertising > 22: Yes (5.9)
## :   Advertising <= 22:
## :   :...ShelveLoc in {Bad,Medium}:
## :       :...CompPrice <= 144: No (37.8/1.3)
## :       :   CompPrice > 144:
## :       :   :...Price <= 147: Yes (17.4/5.4)
## :       :        Price > 147: No (5.8)
## :       ShelveLoc = Good:
## :       :...Price > 156: No (6.5)
## :            Price <= 156:
## :            :...Urban = No: No (9.5/2.4)
## :                Urban = Yes: Yes (16.7/1.7)
## Price <= 126:
```

```
## :...CompPrice <= 123:
##     :...Income <= 53: No (38/9.3)
##     :   Income > 53:
##     :   :...Price <= 86: Yes (13)
##     :       Price > 86:
##     :       :...Advertising > 7: Yes (31.8/6)
##     :           Advertising <= 7:
##     :           :...Education <= 11: Yes (9.5/3.3)
##     :               Education > 11: No (23.4/2.8)
##     CompPrice > 123:
##     :...Advertising > 10: Yes (25)
##         Advertising <= 10:
##         :...Age > 74: No (5.2)
##             Age <= 74:
##             :...Price <= 105: Yes (16.9)
##                 Price > 105:
##                 :...Advertising <= 8: Yes (36.3/10)
##                     Advertising > 8: No (2.6)
##
## -----  Trial 54:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 135: Yes (40.6/2.9)
## :   Price > 135: No (21.4/7.9)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 104:
##     :...CompPrice > 123: Yes (14.4)
##     :   CompPrice <= 123:
##     :   :...Age <= 35: Yes (10.8)
##     :       Age > 35:
##     :       :...Income > 100: Yes (7.4)
##     :           Income <= 100:
##     :           :...ShelveLoc = Bad: No (16.6/3.1)
##     :               ShelveLoc = Medium:
##     :               :...Price <= 83: Yes (4.4)
##     :                   Price > 83: No (24.2/11)
##     Price > 104:
##     :...CompPrice <= 114: No (20.7)
##         CompPrice > 114:
##         :...ShelveLoc = Bad:
##             :...Advertising <= 15: No (39.5/6.1)
##             :   Advertising > 15: Yes (4.8/0.9)
##             ShelveLoc = Medium:
##             :...Age <= 33: Yes (17.3/2.5)
##                 Age > 33:
##                 :...Population <= 303:
##                     :...Advertising <= 10: No (37.1/3.5)
##                     :   Advertising > 10: Yes (10.6/3.9)
##                     Population > 303:
##                     :...Income <= 46: No (5.4/1)
##                         Income > 46: Yes (25.8/5.8)
##
```

```
## -----  Trial 55:  -----
##
## Decision tree:
##
## Price <= 104: Yes (87.7/21.3)
## Price > 104:
## :...ShelveLoc = Good:
##     :...CompPrice <= 100: No (4.1)
##     :   CompPrice > 100:
##     :   :...Age <= 73: Yes (38.2/6.3)
##     :       Age > 73: No (4.5)
##     ShelveLoc in {Bad,Medium}:
##     :...CompPrice > 137:
##         :...Urban = No: No (7.7/1.7)
##         :   Urban = Yes:
##         :   :...Price <= 127: Yes (17.1/1.7)
##         :       Price > 127: No (24.9/11.2)
##         CompPrice <= 137:
##         :...CompPrice <= 114: No (16.5)
##             CompPrice > 114:
##             :...ShelveLoc = Bad: No (23.6/2.6)
##                 ShelveLoc = Medium:
##                 :...Age <= 33: Yes (12.2/2.5)
##                     Age > 33:
##                     :...Price > 127: No (26.3)
##                         Price <= 127:
##                         :...Advertising <= 1: No (14.4/2.1)
##                             Advertising > 1:
##                             :...CompPrice <= 123: No (8.5/1.2)
##                                 CompPrice > 123: Yes (15.5/3.2)
##
## -----  Trial 56:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 156: Yes (46.8/11.5)
## :   Price > 156: No (5.9)
## ShelveLoc in {Bad,Medium}:
## :...CompPrice > 142: Yes (41.6/11.2)
##     CompPrice <= 142:
##     :...Price > 125: No (38.2/2.7)
##         Price <= 125:
##         :...Income > 100: Yes (19.9/3.9)
##             Income <= 100:
##             :...Advertising <= 0:
##                 :...Price <= 72: Yes (3)
##                 :   Price > 72:
##                 :   :...Population <= 504: No (50.1/3.8)
##                 :       Population > 504: Yes (3.8)
##                 Advertising > 0:
##                 :...CompPrice <= 110: No (31.5/6.2)
##                     CompPrice > 110:
##                     :...Age <= 49: Yes (18.5/0.2)
```

```
##                              Age > 49:
##                              :...Age <= 55: No (9.8/0.4)
##                                  Age > 55: Yes (31.8/11.3)
##
## -----  Trial 57:  -----
##
## Decision tree:
##
## Age > 73: No (43.6/6.2)
## Age <= 73:
## :...Price <= 104:
##     :...CompPrice > 121: Yes (18)
##     :   CompPrice <= 121:
##     :   :...Advertising > 7: Yes (23.6/1.4)
##     :       Advertising <= 7:
##     :       :...ShelveLoc = Good: Yes (3.1)
##     :           ShelveLoc in {Bad,Medium}:
##     :           :...Income <= 46: No (10.9)
##     :               Income > 46:
##     :               :...Urban = No: Yes (5.3)
##     :                   Urban = Yes:
##     :                   :...Price <= 77: Yes (5.3)
##     :                       Price > 77: No (18.5/3.8)
##     Price > 104:
##     :...Advertising > 15: Yes (18.5/4.3)
##         Advertising <= 15:
##         :...CompPrice <= 131:
##             :...Price > 131: No (18)
##             :   Price <= 131:
##             :   :...ShelveLoc = Good: Yes (11.7/4.3)
##             :       ShelveLoc = Bad: No (11.8)
##             :       ShelveLoc = Medium:
##             :       :...CompPrice <= 115: No (12.4)
##             :           CompPrice > 115:
##             :           :...Income <= 97: No (17.4/4.3)
##             :               Income > 97: Yes (4.7)
##             CompPrice > 131:
##             :...Urban = No: No (13/2.6)
##                 Urban = Yes:
##                 :...Price > 156: No (7.5)
##                     Price <= 156:
##                     :...ShelveLoc = Good: Yes (10.6)
##                         ShelveLoc in {Bad,Medium}:
##                         :...Price <= 139: Yes (40.7/13.3)
##                             Price > 139: No (6.4)
##
## -----  Trial 58:  -----
##
## Decision tree:
##
## Price <= 100:
## :...Price > 97: Yes (14.6)
## :   Price <= 97:
## :   :...ShelveLoc = Good: Yes (4.7)
```

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```
## :          ShelveLoc in {Bad,Medium}:
## :          :...CompPrice > 123: Yes (9.4)
## :              CompPrice <= 123:
## :              :...Advertising > 7: Yes (15/2.5)
## :                  Advertising <= 7:
## :                  :...Price <= 72: Yes (6.2/1.5)
## :                      Price > 72: No (18.4/1.5)
## Price > 100:
## :...ShelveLoc = Bad:
##     :...Education <= 16: No (46.5/4.7)
##     :   Education > 16: Yes (8.7/1.8)
##     ShelveLoc = Good:
##     :...CompPrice <= 100: No (5.8)
##     :   CompPrice > 100:
##     :   :...Price <= 135: Yes (18.7)
##     :       Price > 135: No (20.4/7)
##     ShelveLoc = Medium:
##     :...Education <= 10: Yes (15.5/4.9)
##         Education > 10:
##         :...Education <= 12: No (29.3/4.8)
##             Education > 12:
##             :...Urban = No:
##                 :...US = No: Yes (13.6/2.9)
##                 :   US = Yes: No (13.4/4.5)
##                 Urban = Yes:
##                 :...Education > 17: No (11.5/0.3)
##                     Education <= 17:
##                     :...Education <= 15: No (25.6/6.8)
##                         Education > 15:
##                         :...Price <= 118: Yes (11.3/0.9)
##                             Price > 118: No (12.4/3.2)
##
## -----  Trial 59:  -----
##
## Decision tree:
##
## ShelveLoc = Bad:
## :...Price > 129: No (14.5)
## :   Price <= 129:
## :   :...Advertising > 15: Yes (5.7)
## :       Advertising <= 15:
## :       :...Population <= 95: No (10.5)
## :           Population > 95:
## :           :...Education > 17: Yes (2.4)
## :               Education <= 17:
## :               :...Price > 125: No (8.4)
## :                   Price <= 125:
## :                   :...CompPrice <= 129: No (28.4/8.4)
## :                       CompPrice > 129: Yes (6.5)
## ShelveLoc in {Good,Medium}:
## :...Price <= 105:
##     :...ShelveLoc = Good: Yes (7.4)
##     :   ShelveLoc = Medium:
##     :   :...Urban = No: Yes (18.3/1.8)
```

```
##      :          Urban = Yes:
##      :          :...Age > 68: No (3.2)
##      :              Age <= 68:
##      :              :...Advertising <= 19: Yes (27.8/7.1)
##      :                  Advertising > 19: No (2.3)
##      Price > 105:
##      :...CompPrice <= 122:
##          :...Education > 15: Yes (11.3/4.6)
##          :   Education <= 15:
##          :   :...Advertising <= 22: No (40.1/2.5)
##          :       Advertising > 22: Yes (2.2)
##          CompPrice > 122:
##          :...ShelveLoc = Good:
##              :...Price <= 156: Yes (21.2/1)
##              :   Price > 156: No (3)
##              ShelveLoc = Medium:
##              :...Income > 108: No (6.5)
##                  Income <= 108:
##                  :...Education <= 16:
##                      :...Urban = No: No (17.9/6.7)
##                      :   Urban = Yes: Yes (40.1/8.7)
##                      Education > 16:
##                      :...Advertising <= 19: No (21.1/4.6)
##                          Advertising > 19: Yes (2.3)
##
## -----  Trial 60:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Age > 77: No (3.5)
## :   Age <= 77:
## :   :...Price <= 156: Yes (37.5/7.5)
## :       Price > 156: No (2.4)
## ShelveLoc in {Bad,Medium}:
## :...Price > 126:
##     :...Advertising > 23: Yes (5.3)
##     :   Advertising <= 23:
##     :   :...CompPrice <= 144: No (48.6/1.3)
##     :       CompPrice > 144:
##     :       :...Education <= 17: No (16.9/4.9)
##     :           Education > 17: Yes (5.7)
##     Price <= 126:
##     :...CompPrice > 139: Yes (13.3)
##         CompPrice <= 139:
##         :...Advertising <= 7:
##             :...Age > 50: No (62.5/12.1)
##             :   Age <= 50:
##             :   :...ShelveLoc = Bad: No (10.1/2.9)
##             :       ShelveLoc = Medium: Yes (26.4/8.8)
##             Advertising > 7:
##             :...CompPrice > 121: Yes (30.2/2.3)
##                 CompPrice <= 121:
##                 :...Income <= 96: No (29.4/9.3)
```

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```
##                     Income > 96: Yes (9.3)
##
## -----  Trial 61:  -----
##
## Decision tree:
##
## Price <= 100: Yes (79.6/16.9)
## Price > 100:
## :...CompPrice > 142: Yes (41.6/11.3)
##     CompPrice <= 142:
##     :...Advertising <= 9: No (102.1/20.1)
##         Advertising > 9:
##         :...Income > 98: Yes (13.8/1.3)
##             Income <= 98:
##             :...ShelveLoc = Bad: No (11.3/2.3)
##                 ShelveLoc = Good: Yes (8.7/3.1)
##                 ShelveLoc = Medium:
##                 :...Education > 16: No (7.7)
##                     Education <= 16:
##                     :...Age <= 41: Yes (10.5)
##                         Age > 41: No (25.9/9.3)
##
## -----  Trial 62:  -----
##
## Decision tree:
##
## Price > 126:
## :...ShelveLoc = Bad: No (15.8/1.1)
## :    ShelveLoc in {Good,Medium}:
## :    :...Urban = No: No (22.4/4.3)
## :        Urban = Yes:
## :        :...Age <= 33: Yes (8.3/0.7)
## :            Age > 33: No (43.1/14.3)
## Price <= 126:
## :...CompPrice > 123:
##     :...Advertising > 10: Yes (22.5)
##     :   Advertising <= 10:
##     :   :...Age <= 74: Yes (52.6/12.5)
##     :       Age > 74: No (5.6)
##     CompPrice <= 123:
##     :...Price <= 70: Yes (8.9)
##         Price > 70:
##         :...US = No:
##             :...Education <= 10: Yes (3.6/0.4)
##             :   Education > 10: No (43.6/7.1)
##             US = Yes:
##             :...Urban = No:
##                 :...CompPrice <= 99: No (3.2)
##                 :   CompPrice > 99: Yes (18.9/1.8)
##                 Urban = Yes:
##                 :...Advertising <= 0: No (5.7)
##                     Advertising > 0:
##                     :...ShelveLoc = Bad: No (16.4/6.5)
##                         ShelveLoc = Good: Yes (2.1)
```

```
##                                  ShelveLoc = Medium:
##                                  :...CompPrice <= 116: Yes (19.5/3.9)
##                                       CompPrice > 116: No (8.8/0.2)
##
## -----  Trial 63:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Income <= 42: No (18.8/7.8)
## :   Income > 42: Yes (35.2/2.7)
## ShelveLoc in {Bad,Medium}:
## :...Advertising <= 7:
##     :...Urban = No:
##     :   :...Income > 88: Yes (15.5/2.2)
##     :   :   Income <= 88:
##     :   :   :...Population <= 492: No (22.3/1.9)
##     :   :        Population > 492: Yes (5.6/0.1)
##     :   Urban = Yes:
##     :   :...Price <= 70: Yes (4.9)
##     :        Price > 70:
##     :        :...ShelveLoc = Bad: No (27.4/5.8)
##     :            ShelveLoc = Medium:
##     :            :...US = No: No (38.4/12)
##     :                US = Yes:
##     :                :...Age <= 34: Yes (3.8)
##     :                    Age > 34: No (22.8/3.3)
##     Advertising > 7:
##     :...Price <= 89: Yes (15.1)
##         Price > 89:
##         :...Advertising > 21: Yes (8)
##             Advertising <= 21:
##             :...Education <= 10: Yes (13.3/1.3)
##                 Education > 10:
##                 :...Price > 126: No (20.7/3.5)
##                     Price <= 126:
##                     :...Age <= 59: Yes (28.4/6.1)
##                         Age > 59: No (20.7/5)
##
## -----  Trial 64:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 135: Yes (40.2/2.5)
## :   Price > 135: No (17.3/6.4)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 100:
##     :...CompPrice > 123: Yes (17.1)
##     :   CompPrice <= 123:
##     :   :...Price > 97: Yes (11)
##     :        Price <= 97:
##     :        :...Income <= 50: No (9.6/0.8)
##     :            Income > 50:
```

```
##      :                :...Urban = No: Yes (12.2)
##      :                   Urban = Yes:
##      :                   :...Price <= 86: Yes (10.2)
##      :                       Price > 86: No (12.8/2.2)
##      Price > 100:
##      :...CompPrice > 142: Yes (41/10.8)
##          CompPrice <= 142:
##          :...Advertising > 10:
##              :...Price > 126: No (12.7/2)
##              :   Price <= 126:
##              :   :...CompPrice <= 121: No (18.3/6.8)
##              :       CompPrice > 121: Yes (17.2)
##              Advertising <= 10:
##              :...ShelveLoc = Bad: No (18.1)
##                  ShelveLoc = Medium:
##                  :...Age > 74: No (9.3)
##                      Age <= 74:
##                      :...Age > 72: Yes (4)
##                          Age <= 72:
##                          :...Education <= 12: No (15.1)
##                              Education > 12:
##                              :...Income <= 95: No (28.3/6.8)
##                                  Income > 95: Yes (6.5/0.4)
##
## -----  Trial 65:  -----
##
## Decision tree:
##
## Price <= 104: Yes (98.6/21.9)
## Price > 104:
## :...ShelveLoc = Good:
##      :...Urban = No: No (16.2/7)
##      :   Urban = Yes:
##      :   :...Price <= 156: Yes (32.1/1.3)
##      :       Price > 156: No (2.3)
##      ShelveLoc in {Bad,Medium}:
##      :...CompPrice <= 114: No (13.7)
##          CompPrice > 114:
##          :...Population > 393:
##              :...Price <= 136: Yes (32.9/4.7)
##              :   Price > 136: No (14.3/4.8)
##              Population <= 393:
##              :...Price > 139: No (16)
##                  Price <= 139:
##                  :...ShelveLoc = Bad: No (22.9/3.4)
##                      ShelveLoc = Medium:
##                      :...Age <= 33: Yes (9.9)
##                          Age > 33: No (42.2/13.8)
##
## -----  Trial 66:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
```

```
## :...CompPrice <= 98: No (3.8/0.3)
## :   CompPrice > 98: Yes (51.6/7.9)
## ShelveLoc in {Bad,Medium}:
## :...Advertising <= 7:
##     :...Price > 144: No (14)
##     :   Price <= 144:
##     :   :...Age > 76: No (9.2)
##     :       Age <= 76:
##     :       :...CompPrice <= 122:
##     :           :...Price <= 70: Yes (4.3)
##     :           :   Price > 70: No (50.7/10.2)
##     :           CompPrice > 122:
##     :           :...Price <= 104: Yes (11.8)
##     :               Price > 104:
##     :               :...US = Yes: No (13.4/3.7)
##     :                   US = No:
##     :                   :...ShelveLoc = Bad: No (6/1.2)
##     :                       ShelveLoc = Medium: Yes (28.3/7.2)
##     Advertising > 7:
##     :...ShelveLoc = Bad:
##         :...Income <= 97: No (22/5.3)
##         :   Income > 97: Yes (7.7/0.4)
##         ShelveLoc = Medium:
##         :...Price <= 103: Yes (17.6)
##             Price > 103:
##             :...CompPrice > 135: Yes (15/0.2)
##                 CompPrice <= 135:
##                 :...CompPrice <= 114: No (11.3/2.6)
##                     CompPrice > 114:
##                     :...Age <= 39: Yes (6.9)
##                         Age > 39:
##                         :...Price <= 127: Yes (19.3/4.1)
##                             Price > 127: No (8.1)
##
## -----  Trial 67:  -----
##
## Decision tree:
##
## Price > 134:
## :...CompPrice <= 136: No (23.1)
## :   CompPrice > 136:
## :   :...Advertising > 20: Yes (3.2)
## :       Advertising <= 20:
## :       :...Price <= 156: Yes (25.5/10.4)
## :           Price > 156: No (12)
## Price <= 134:
## :...ShelveLoc = Good: Yes (30.5/2.7)
##     ShelveLoc in {Bad,Medium}:
##     :...Advertising <= 0:
##         :...CompPrice > 142: Yes (8)
##         :   CompPrice <= 142:
##         :   :...Price > 100: No (38/3.9)
##         :       Price <= 100:
##         :       :...Population <= 335: No (13.6/4.3)
```

```
##           :              Population > 335: Yes (14.4/1)
##          Advertising > 0:
##          :...Age <= 47:
##              :...CompPrice <= 157: Yes (53.2/7)
##              :   CompPrice > 157: No (2.4)
##             Age > 47:
##              :...Price <= 89: Yes (10.5)
##                 Price > 89:
##                 :...Population <= 266:
##                     :...Age <= 73: Yes (24.9/5.6)
##                     :   Age > 73: No (3.6)
##                     Population > 266:
##                     :...Income <= 113: No (35.1/5.5)
##                         Income > 113: Yes (3)
##
## -----  Trial 68:  -----
##
## Decision tree:
##
## Price > 126:
## :...ShelveLoc = Good:
## :   :...Price <= 135: Yes (7.1)
## :   :   Price > 135: No (22.1/7.6)
## :   ShelveLoc in {Bad,Medium}:
## :   :...CompPrice <= 142: No (46.4/2.8)
## :       CompPrice > 142:
## :       :...Advertising > 19: Yes (2.5)
## :           Advertising <= 19:
## :           :...Price <= 147: Yes (18.9/6.6)
## :               Price > 147: No (11)
## Price <= 126:
## :...CompPrice > 139: Yes (12.7)
##     CompPrice <= 139:
##     :...ShelveLoc = Good: Yes (17.5/3.8)
##         ShelveLoc = Bad:
##         :...Income <= 50: No (12.9/1.7)
##         :   Income > 50:
##         :   :...Population <= 149: No (5.5)
##         :       Population > 149: Yes (23.9/6.3)
##         ShelveLoc = Medium:
##         :...Price <= 104: Yes (55.3/13)
##             Price > 104:
##             :...CompPrice <= 115: No (12.5)
##                 CompPrice > 115:
##                 :...Age <= 33: Yes (7.8)
##                     Age > 33:
##                     :...Advertising <= 10: No (29.2/7.1)
##                         Advertising > 10: Yes (15.7/3.4)
##
## -----  Trial 69:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
```

```
## :...Age > 77: No (4.4)
## :    Age <= 77:
## :    :...Income <= 42: No (16.6/6.2)
## :        Income > 42: Yes (27.2/2)
## ShelveLoc in {Bad,Medium}:
## :...Advertising > 15: Yes (24.9/7.4)
##     Advertising <= 15:
##     :...Price > 144: No (14.9)
##         Price <= 144:
##         :...Income > 101: Yes (20.1/4.9)
##             Income <= 101:
##             :...ShelveLoc = Bad:
##                 :...Education > 17: Yes (3.8/0.5)
##                 :    Education <= 17:
##                 :    :...Price > 125: No (16.4)
##                 :        Price <= 125:
##                 :        :...CompPrice <= 131: No (35/6.3)
##                 :            CompPrice > 131: Yes (7.7/0.6)
##                 ShelveLoc = Medium:
##                 :...Price <= 84: Yes (7.6)
##                     Price > 84:
##                     :...Income <= 24: No (9.3)
##                         Income > 24:
##                         :...Education <= 11:
##                             :...Population <= 151: No (9/1.5)
##                             :    Population > 151: Yes (17.7/1.9)
##                             Education > 11:
##                             :...US = No:
##                                 :...CompPrice <= 143: No (27.2/8.6)
##                                 :    CompPrice > 143: Yes (7.6)
##                                 US = Yes:
##                                 :...Income > 67: No (27.2/0.3)
##                                     Income <= 67:
##                                     :...Price <= 115: Yes (12.8/0.2)
##                                         Price > 115: No (11.6/1.3)
##
## -----  Trial 70:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 156: Yes (48.6/11.8)
## :    Price > 156: No (2.8)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 100:
##     :...CompPrice > 123: Yes (16.1)
##     :    CompPrice <= 123:
##     :    :...Price > 97: Yes (8.2)
##     :        Price <= 97:
##     :        :...Price <= 81: Yes (13.6/2.1)
##     :            Price > 81:
##     :            :...Income <= 100: No (22.2/2.7)
##     :                Income > 100: Yes (3.9)
##     Price > 100:
```

```
##     :...Age > 58:
##        :...Advertising <= 3: No (23.7)
##        :   Advertising > 3:
##        :   :...US = No: Yes (6.2/0.1)
##        :       US = Yes: No (44.6/6.1)
##        Age <= 58:
##        :...Advertising > 20: Yes (6)
##            Advertising <= 20:
##            :...Price > 126:
##                :...Education <= 10: Yes (6.2/1.5)
##                :   Education > 10: No (34.9/2.1)
##                Price <= 126:
##                :...Advertising > 10: Yes (19.4/1.3)
##                    Advertising <= 10:
##                    :...ShelveLoc = Bad: No (9.6/1.2)
##                        ShelveLoc = Medium:
##                        :...Education <= 12: No (8.6/0.4)
##                            Education > 12: Yes (26.5/8.6)
##
## -----  Trial 71:  -----
##
## Decision tree:
##
## Price <= 100:
## :...Advertising > 7: Yes (22.5/1.1)
## :   Advertising <= 7:
## :   :...CompPrice > 124: Yes (10.8)
## :       CompPrice <= 124:
## :       :...ShelveLoc = Good: Yes (3.9)
## :           ShelveLoc in {Bad,Medium}:
## :           :...Price > 97: Yes (4.7)
## :               Price <= 97:
## :               :...Price <= 70: Yes (4.3)
## :                   Price > 70: No (22.7/3.1)
## Price > 100:
## :...CompPrice <= 123: No (97/18.4)
##     CompPrice > 123:
##     :...Price > 126:
##         :...Urban = No: No (15.2/0.9)
##         :   Urban = Yes:
##         :   :...ShelveLoc in {Bad,Medium}: No (36.1/10.3)
##         :       ShelveLoc = Good: Yes (12.7/2.2)
##         Price <= 126:
##         :...Advertising > 10: Yes (25.4)
##             Advertising <= 10:
##             :...CompPrice > 140: Yes (7.3)
##                 CompPrice <= 140:
##                 :...ShelveLoc = Bad: No (5)
##                     ShelveLoc = Good: Yes (2.8)
##                     ShelveLoc = Medium:
##                     :...US = Yes: No (8/0.7)
##                         US = No:
##                         :...Advertising <= 1: No (17/5.6)
##                             Advertising > 1: Yes (5.6)
```

```
## 
## -----  Trial 72:  -----
## 
## Decision tree:
## 
## Age > 73: No (37.4/8.4)
## Age <= 73:
## :...Advertising <= 7:
##     :...Price > 129: No (30.1/6)
##     :   Price <= 129:
##     :   :...ShelveLoc = Good: Yes (17/4.4)
##     :       ShelveLoc = Bad:
##     :       :...Advertising > 3: No (5.5)
##     :       :   Advertising <= 3:
##     :       :   :...CompPrice <= 147: No (16.4/5.1)
##     :       :       CompPrice > 147: Yes (7.2)
##     :       ShelveLoc = Medium:
##     :       :...Urban = No: Yes (20/5.4)
##     :           Urban = Yes:
##     :           :...CompPrice > 129: Yes (13.8/2.7)
##     :               CompPrice <= 129:
##     :               :...Price > 115: No (9.2)
##     :                   Price <= 115:
##     :                   :...Age <= 36: Yes (5.5)
##     :                       Age > 36: No (17.1/5.4)
##     Advertising > 7:
##     :...Price <= 109: Yes (40.6/2.2)
##         Price > 109:
##         :...Advertising > 19: Yes (10.7)
##             Advertising <= 19:
##             :...US = No: Yes (2.8)
##                 US = Yes:
##                 :...ShelveLoc = Good: Yes (17.3/2.4)
##                     ShelveLoc in {Bad,Medium}:
##                     :...CompPrice <= 114: No (8.7)
##                         CompPrice > 114:
##                         :...Education <= 10: Yes (9.5/1.5)
##                             Education > 10:
##                             :...Price <= 126: Yes (20.9/7.9)
##                                 Price > 126: No (11.5)
## 
## -----  Trial 73:  -----
## 
## Decision tree:
## 
## Income <= 52:
## :...CompPrice <= 112: No (30.8/0.7)
## :   CompPrice > 112:
## :   :...Education > 17: Yes (6.3/0.1)
## :       Education <= 17:
## :       :...Price <= 92: Yes (4.9)
## :           Price > 92:
## :           :...Advertising <= 3: No (25.8/3.9)
## :               Advertising > 3:
```

```
## :                  :...Price > 141: No (4)
## :                     Price <= 141:
## :                     :...CompPrice > 131: Yes (10.4)
## :                           CompPrice <= 131:
## :                           :...CompPrice <= 116: Yes (6.3)
## :                                  CompPrice > 116: No (16/4.4)
## Income > 52:
## :...Price <= 107: Yes (74.9/11.8)
##     Price > 107:
##     :...ShelveLoc = Bad: No (23.4/3.9)
##         ShelveLoc in {Good,Medium}:
##         :...Age <= 33: Yes (19.2/0.7)
##             Age > 33:
##             :...Population <= 303:
##                 :...ShelveLoc = Good: Yes (14.5/5)
##                 :   ShelveLoc = Medium: No (27.8/3.6)
##                 Population > 303:
##                 :...Price <= 111: No (3/0.1)
##                     Price > 111:
##                     :...ShelveLoc = Good: Yes (7.3)
##                         ShelveLoc = Medium:
##                         :...CompPrice <= 114: No (2.8)
##                             CompPrice > 114: Yes (23.7/1.8)
##
## -----  Trial 74:  -----
##
## Decision tree:
##
## CompPrice > 143:
## :...Price <= 154: Yes (35.9/3.9)
## :   Price > 154: No (6.1/1.1)
## CompPrice <= 143:
## :...Price > 134: No (32.8/3)
##     Price <= 134:
##     :...ShelveLoc = Good:
##         :...CompPrice <= 98: No (5.8/1.5)
##         :   CompPrice > 98: Yes (25.5)
##         ShelveLoc in {Bad,Medium}:
##         :...Advertising > 11:
##             :...CompPrice > 121: Yes (26.9/2.4)
##             :   CompPrice <= 121:
##             :   :...Age <= 59: Yes (12.7/2.6)
##             :       Age > 59: No (14.2/1.5)
##             Advertising <= 11:
##             :...Price > 101:
##                 :...CompPrice <= 115: No (18.6)
##                 :   CompPrice > 115:
##                 :   :...Income <= 96: No (45.7/9)
##                 :       Income > 96: Yes (13.1/3.7)
##                 Price <= 101:
##                 :...CompPrice > 124: Yes (10.6)
##                     CompPrice <= 124:
##                     :...Price <= 70: Yes (7.9)
##                         Price > 70:
```

```
##                            :...Price > 97: Yes (10.6/1.4)
##                                Price <= 97:
##                                :...Income > 102: Yes (5.1)
##                                    Income <= 102:
##                                    :...Advertising <= 7: No (22.8/1.1)
##                                        Advertising > 7: Yes (7/2.1)
##
## -----  Trial 75:  -----
##
## Decision tree:
##
## Price <= 80: Yes (16.1/1.2)
## Price > 80:
## :...ShelveLoc = Good:
##     :...Age <= 77: Yes (43.1/11.5)
##     :   Age > 77: No (3.9)
##     ShelveLoc in {Bad,Medium}:
##     :...CompPrice <= 123:
##         :...Income > 100: Yes (15.9/4.6)
##         :   Income <= 100:
##         :   :...Age <= 35: Yes (16.1/6.5)
##         :       Age > 35:
##         :       :...Price > 102: No (38.9)
##         :           Price <= 102:
##         :           :...US = No: No (15.3/1.4)
##         :               US = Yes:
##         :               :...Population <= 266: Yes (15.5/3.9)
##         :                   Population > 266: No (10.9)
##         CompPrice > 123:
##         :...Price <= 105: Yes (16)
##             Price > 105:
##             :...Advertising > 21: Yes (7.2)
##                 Advertising <= 21:
##                 :...Price > 125:
##                     :...Education <= 10: Yes (6.9/1.7)
##                     :   Education > 10: No (43.8/7)
##                     Price <= 125:
##                     :...Advertising > 10: Yes (17.2)
##                         Advertising <= 10:
##                         :...US = Yes: No (4.6)
##                             US = No:
##                             :...Advertising > 1: Yes (5.9)
##                                 Advertising <= 1:
##                                 :...CompPrice <= 141: No (19.2/4.5)
##                                     CompPrice > 141: Yes (4.5)
##
## -----  Trial 76:  -----
##
## Decision tree:
##
## CompPrice <= 123:
## :...Price <= 100:
## :   :...ShelveLoc = Bad: No (17/5.3)
## :   :   ShelveLoc in {Good,Medium}: Yes (35.2/9.8)
```

```
## :    Price > 100:
## :    :...Advertising <= 5: No (57.7/3.4)
## :         Advertising > 5:
## :         :...Income <= 98: No (41.1/10.7)
## :             Income > 98: Yes (10.6/2.3)
## CompPrice > 123:
## :...Price <= 126:
##     :...Advertising > 10: Yes (18.4)
##     :    Advertising <= 10:
##     :    :...Age <= 74: Yes (45.3/11.9)
##     :         Age > 74: No (5.1)
##     Price > 126:
##     :...CompPrice <= 136: No (24/1.5)
##         CompPrice > 136:
##         :...Income > 82: Yes (15.9/2.4)
##             Income <= 82:
##             :...Advertising <= 16: No (26.6/8.6)
##                 Advertising > 16: Yes (4.3)
##
## -----  Trial 77:  -----
##
## Decision tree:
##
## Advertising > 7:
## :...Advertising > 21: Yes (9.4)
## :    Advertising <= 21:
## :    :...ShelveLoc = Good:
## :         :...Population <= 236: No (7.4/2.3)
## :         :    Population > 236: Yes (18.4)
## :         ShelveLoc in {Bad,Medium}:
## :         :...Advertising <= 9: Yes (9.5/0.5)
## :             Advertising > 9:
## :             :...Price > 126:
## :                 :...Education <= 10: Yes (4.9/1.3)
## :                 :    Education > 10: No (17.7)
## :                 Price <= 126:
## :                 :...CompPrice > 129: Yes (9.5)
## :                     CompPrice <= 129:
## :                     :...Income <= 56: No (12.1/1.2)
## :                         Income > 56: Yes (29.8/9.5)
## Advertising <= 7:
## :...CompPrice > 147:
##     :...CompPrice <= 157: Yes (23.7/4.4)
##     :    CompPrice > 157: No (2.7/0.1)
##     CompPrice <= 147:
##     :...Price > 129: No (27)
##         Price <= 129:
##         :...Price <= 70: Yes (7.4)
##             Price > 70:
##             :...ShelveLoc = Good: Yes (12.4/4.1)
##                 ShelveLoc = Bad:
##                 :...Education <= 10: Yes (2.4)
##                 :    Education > 10: No (25.6/2)
##                 ShelveLoc = Medium:
```

```
##                     :...Population > 492: Yes (6.9)
##                        Population <= 492:
##                        :...Age > 50: No (44.1/5)
##                           Age <= 50:
##                           :...US = Yes: Yes (5.9)
##                              US = No:
##                              :...Income <= 95: No (13.4/0.9)
##                                 Income > 95: Yes (10.6/2.5)
##
## -----  Trial 78:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Urban = No: No (19.6/8)
## :   Urban = Yes:
## :   :...Price <= 156: Yes (33.3/1.3)
## :       Price > 156: No (4.9)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 100:
##     :...CompPrice > 123: Yes (16.7)
##     :   CompPrice <= 123:
##     :   :...Price > 97: Yes (6.6)
##     :       Price <= 97:
##     :       :...Income > 100: Yes (7.3)
##     :           Income <= 100:
##     :           :...Price <= 81: Yes (11.2/2.3)
##     :               Price > 81: No (19.6/2.8)
##     Price > 100:
##     :...CompPrice <= 123: No (78.4/12)
##         CompPrice > 123:
##         :...Urban = No: No (33.6/10.7)
##             Urban = Yes:
##             :...CompPrice > 142: Yes (26.8/6)
##                 CompPrice <= 142:
##                 :...Advertising <= 3: No (15.3/2)
##                     Advertising > 3:
##                     :...Price <= 126: Yes (13.1)
##                         Price > 126: No (14.6/1.6)
##
## -----  Trial 79:  -----
##
## Decision tree:
##
## Price > 144: No (30/4.3)
## Price <= 144:
## :...ShelveLoc = Good:
##     :...Age <= 27: No (5.4/1.1)
##     :   Age > 27: Yes (48.1/2.4)
##     ShelveLoc in {Bad,Medium}:
##     :...Age <= 49:
##         :...CompPrice > 114: Yes (67.2/15.8)
##         :   CompPrice <= 114:
##         :   :...Price <= 105: Yes (15/4)
```

```
##         :          Price > 105: No (12)
##        Age > 49:
##        :...Education > 17: Yes (11/2.1)
##            Education <= 17:
##            :...Price > 105: No (60/11)
##                Price <= 105:
##                :...CompPrice > 123: Yes (12.7)
##                    CompPrice <= 123:
##                    :...Income > 100: Yes (4.3)
##                        Income <= 100:
##                        :...US = No: No (10.6/2.3)
##                            US = Yes:
##                            :...Population <= 272: Yes (16.8/6.4)
##                                Population > 272: No (8/0.1)
##
## -----  Trial 80:  -----
##
## Decision tree:
##
## Advertising > 15: Yes (28.5/4)
## Advertising <= 15:
## :...ShelveLoc = Good: Yes (52.6/14.5)
##     ShelveLoc = Bad: No (67.7/16.4)
##     ShelveLoc = Medium:
##     :...Price > 127:
##         :...Advertising <= 3: No (14.5)
##         :   Advertising > 3:
##         :   :...US = No: Yes (5.9/0.9)
##         :       US = Yes: No (21/4.3)
##         Price <= 127:
##         :...Price <= 86: Yes (7.9)
##             Price > 86:
##             :...CompPrice <= 115: No (37.9/10.4)
##                 CompPrice > 115:
##                 :...Age <= 33: Yes (9.9)
##                     Age > 33:
##                     :...Urban = No:
##                         :...Price <= 119: Yes (20.3/3.3)
##                         :   Price > 119: No (3.6)
##                         Urban = Yes:
##                         :...CompPrice <= 123: No (9.1/0.9)
##                             CompPrice > 123: Yes (22.1/4.5)
##
## -----  Trial 81:  -----
##
## Decision tree:
##
## Price <= 105:
## :...Urban = No: Yes (37.2/3.5)
## :   Urban = Yes:
## :   :...CompPrice > 124: Yes (13.5)
## :       CompPrice <= 124:
## :       :...ShelveLoc = Good: Yes (3.4)
## :           ShelveLoc in {Bad,Medium}:
```

```
## :              :...Population > 488: Yes (6)
## :               Population <= 488:
## :               :...Advertising <= 7: No (24.4/5.6)
## :                   Advertising > 7: Yes (17.6/4.9)
## Price > 105:
## :...ShelveLoc = Bad: No (43.3/9.9)
##     ShelveLoc = Good:
##     :...Income <= 43: No (19.5/3.8)
##     :   Income > 43: Yes (26.7/5.5)
##     ShelveLoc = Medium:
##     :...CompPrice <= 114: No (14.4)
##         CompPrice > 114:
##         :...Age <= 33: Yes (17.9/3.2)
##             Age > 33:
##             :...Education <= 10: Yes (12.1/3.6)
##                 Education > 10:
##                 :...Income <= 45: No (10.9)
##                     Income > 45:
##                     :...Advertising > 19: Yes (3.1)
##                         Advertising <= 19:
##                         :...US = Yes: No (22.6/4.9)
##                             US = No:
##                             :...Population <= 178: No (8.7)
##                                 Population > 178: Yes (19.9/7)
##
## -----  Trial 82:  -----
##
## Decision tree:
##
## Price > 135:
## :...CompPrice <= 136: No (29.3)
## :   CompPrice > 136:
## :   :...Advertising > 20: Yes (2.5)
## :       Advertising <= 20:
## :       :...Income <= 82: No (14.5/0.9)
## :           Income > 82: Yes (8.5/2.3)
## Price <= 135:
## :...ShelveLoc = Good: Yes (33.5/3.5)
##     ShelveLoc in {Bad,Medium}:
##     :...Age > 73:
##         :...Population <= 455: No (25.6/1.6)
##         :   Population > 455: Yes (3.3)
##         Age <= 73:
##         :...Price <= 104:
##             :...Income > 53: Yes (51.7/6.2)
##             :   Income <= 53:
##             :   :...CompPrice <= 119: No (14.3/0.6)
##             :       CompPrice > 119: Yes (9.2)
##             Price > 104:
##             :...CompPrice > 142: Yes (20.4/3.3)
##                 CompPrice <= 142:
##                 :...Advertising > 10:
##                     :...CompPrice <= 113: No (4.3)
##                     :   CompPrice > 113: Yes (31/7.3)
```

```
##                        Advertising <= 10:
##                        :...ShelveLoc = Bad: No (14)
##                            ShelveLoc = Medium:
##                            :...US = Yes: No (13.9/2)
##                                US = No:
##                                :...Advertising > 2: Yes (3.6)
##                                    Advertising <= 2:
##                                    :...Income <= 95: No (14.8)
##                                        Income > 95: Yes (7/2.2)
##
## -----  Trial 83:  -----
##
## Decision tree:
##
## Price > 129:
## :...ShelveLoc = Bad: No (17.5)
## :    ShelveLoc in {Good,Medium}:
## :    :...CompPrice <= 134: No (32.1/2)
## :        CompPrice > 134:
## :        :...Advertising <= 7: No (19.3/4.6)
## :            Advertising > 7: Yes (14.8/3.7)
## Price <= 129:
## :...ShelveLoc = Good:
##     :...CompPrice <= 98: No (6.2/0.7)
##     :    CompPrice > 98: Yes (20.6)
##     ShelveLoc in {Bad,Medium}:
##     :...Price <= 86: Yes (20.7/3.9)
##         Price > 86:
##         :...Age > 73: No (20.5/1.9)
##             Age <= 73:
##             :...CompPrice > 131: Yes (34.3/10.3)
##                 CompPrice <= 131:
##                 :...US = No: No (37.6/7.2)
##                     US = Yes:
##                     :...Price > 126: No (7.8)
##                         Price <= 126:
##                         :...Age <= 49: Yes (22.1/2.8)
##                             Age > 49:
##                             :...Income > 110: Yes (4.3)
##                                 Income <= 110:
##                                 :...Population > 272: No (20.2/1.1)
##                                     Population <= 272:
##                                     :...Advertising <= 1: No (6.4)
##                                         Advertising > 1: Yes (16.6/3.7)
##
## -----  Trial 84:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Education > 15: Yes (15.7/0.9)
## :    Education <= 15:
## :    :...Urban = No: No (14.4/4.9)
## :        Urban = Yes: Yes (19.7/5.5)
```

```
## ShelveLoc in {Bad,Medium}:
## :...Price > 115:
##      :...CompPrice <= 142: No (103.3/17.7)
##      :   CompPrice > 142:
##      :   :...Education <= 12: Yes (4.5)
##      :       Education > 12:
##      :       :...Education <= 17: No (20.7/5.8)
##      :              Education > 17: Yes (5.9/0.4)
##      Price <= 115:
##      :...CompPrice > 122: Yes (32/3.7)
##          CompPrice <= 122:
##          :...Age > 68: No (19.9/1)
##              Age <= 68:
##              :...Advertising > 9: Yes (15.4/1.5)
##                  Advertising <= 9:
##                  :...Price <= 70: Yes (4.9)
##                      Price > 70:
##                      :...Urban = No: Yes (10/3.9)
##                          Urban = Yes:
##                          :...Age <= 35: Yes (4.2)
##                              Age > 35: No (30.5/4)
##
## -----  Trial 85:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 135: Yes (31.8/3.5)
## :   Price > 135: No (20.9/6.5)
## ShelveLoc in {Bad,Medium}:
## :...Price > 126:
##      :...Advertising <= 23: No (64/11.3)
##      :   Advertising > 23: Yes (5.5)
##      Price <= 126:
##      :...CompPrice > 121:
##          :...Advertising > 10: Yes (26.8)
##          :   Advertising <= 10:
##          :   :...CompPrice > 139: Yes (7.8)
##          :       CompPrice <= 139:
##          :       :...Price <= 104: Yes (12.9/1.2)
##          :           Price > 104: No (38.4/11.3)
##          CompPrice <= 121:
##          :...Income > 115: Yes (6.1)
##              Income <= 115:
##              :...Age > 68: No (15.2)
##                  Age <= 68:
##                  :...Price > 115: No (12.9)
##                      Price <= 115:
##                      :...US = No: No (23.8/7.2)
##                          US = Yes:
##                          :...Age <= 39: Yes (6.4)
##                              Age > 39:
##                              :...Price <= 103: Yes (22.6/9.2)
##                                  Price > 103: No (5.9)
```

```
##
## -----  Trial 86:  -----
##
## Decision tree:
##
## ShelveLoc = Bad:
## :...Education > 17: Yes (6.1/0.4)
## :   Education <= 17:
## :   :...Price > 125: No (16.8)
## :       Price <= 125:
## :       :...Income > 98: Yes (8.7/0.4)
## :           Income <= 98:
## :           :...CompPrice <= 131: No (35.1/6.3)
## :               CompPrice > 131: Yes (7.7/0.9)
## ShelveLoc in {Good,Medium}:
## :...Price <= 86: Yes (15.9)
##     Price > 86:
##     :...CompPrice <= 121:
##         :...US = No:
##         :   :...Population <= 504: No (23.8/1.8)
##         :   :   Population > 504: Yes (3.3)
##         :   US = Yes:
##         :   :...ShelveLoc = Good: Yes (11.1/2.6)
##         :       ShelveLoc = Medium:
##         :       :...Age <= 46: Yes (12.2/3)
##         :           Age > 46:
##         :           :...Urban = No: Yes (4.6/1.1)
##         :               Urban = Yes: No (28.2/4.2)
##         CompPrice > 121:
##         :...Price > 156: No (10/0.5)
##             Price <= 156:
##             :...ShelveLoc = Good: Yes (24.5/0.7)
##                 ShelveLoc = Medium:
##                 :...Age <= 38: Yes (24.2/2.1)
##                     Age > 38:
##                     :...CompPrice > 143: Yes (15/0.5)
##                         CompPrice <= 143:
##                         :...Price > 127: No (18/1.4)
##                             Price <= 127:
##                             :...CompPrice > 132: No (4.5/0.4)
##                                 CompPrice <= 132:
##                                 :...Age <= 42: No (3.2)
##                                     Age > 42: Yes (28/4.6)
##
## -----  Trial 87:  -----
##
## Decision tree:
##
## Price <= 100:
## :...Price > 97: Yes (13.6)
## :   Price <= 97:
## :   :...Price <= 70: Yes (12.7)
## :       Price > 70:
## :       :...Advertising > 7: Yes (17.9/1)
```

```
## :             Advertising <= 7:
## :             :...Education <= 10: Yes (5.3)
## :                 Education > 10:
## :                 :...CompPrice <= 124: No (24.2/3)
## :                     CompPrice > 124: Yes (3.8)
## Price > 100:
## :...Advertising > 15: Yes (27.3/7.2)
##     Advertising <= 15:
##     :...ShelveLoc = Bad: No (36.6/7.1)
##         ShelveLoc = Good:
##         :...Age > 73: No (6.3)
##         :   Age <= 73:
##         :   :...Urban = No: No (16.3/6.9)
##         :       Urban = Yes: Yes (23.7/2.4)
##         ShelveLoc = Medium:
##         :...CompPrice <= 124: No (38.3/6.4)
##             CompPrice > 124:
##             :...Price > 144: No (9.1)
##                 Price <= 144:
##                 :...Age <= 33: Yes (11.6)
##                     Age > 33:
##                     :...CompPrice > 142: Yes (14/2)
##                         CompPrice <= 142:
##                         :...Education > 16: No (9.2)
##                             Education <= 16:
##                             :...Population <= 296: No (18.1/3.8)
##                                 Population > 296: Yes (13.3/3.3)
##
## -----  Trial 88:  -----
##
## Decision tree:
##
## Age > 73: No (34/7.1)
## Age <= 73:
## :...ShelveLoc = Good:
##     :...Price <= 156: Yes (48/7.5)
##     :   Price > 156: No (4.9)
##     ShelveLoc in {Bad,Medium}:
##     :...Education <= 10: Yes (19.8/2.2)
##         Education > 10:
##         :...Price > 125:
##             :...Advertising <= 22: No (49.3/7)
##             :   Advertising > 22: Yes (5.4)
##             Price <= 125:
##             :...Price <= 70: Yes (9.2)
##                 Price > 70:
##                 :...CompPrice > 131: Yes (27.4/4.7)
##                     CompPrice <= 131:
##                     :...ShelveLoc = Bad:
##                         :...Advertising <= 12: No (18.2/0.8)
##                         :   Advertising > 12: Yes (5.4)
##                         ShelveLoc = Medium:
##                         :...Advertising > 18: No (5.3)
##                             Advertising <= 18:
```

```
##                                        :...Price <= 104: Yes (41.5/10.6)
##                                            Price > 104:
##                                            :...CompPrice <= 115: No (9.8)
##                                                CompPrice > 115:
##                                                :...Price <= 111: No (4.8/0.2)
##                                                    Price > 111: Yes (18.1/4.7)
##
## -----  Trial 89:  -----
##
## Decision tree:
##
## Price <= 86: Yes (24.7/3.2)
## Price > 86:
## :...CompPrice > 146: Yes (36/8.9)
##     CompPrice <= 146:
##     :...Advertising > 8:
##         :...ShelveLoc = Good: Yes (20.4/3.5)
##         :   ShelveLoc in {Bad,Medium}:
##         :   :...Price > 126:
##         :       :...Advertising <= 23: No (22.8/3)
##         :       :   Advertising > 23: Yes (3)
##         :       Price <= 126:
##         :       :...CompPrice > 121: Yes (26.4/2.8)
##         :           CompPrice <= 121:
##         :           :...Income <= 57: No (10.5)
##         :               Income > 57: Yes (19.5/5.9)
##         Advertising <= 8:
##         :...Price > 129: No (24.3)
##             Price <= 129:
##             :...ShelveLoc = Good: Yes (17.4/4.5)
##                 ShelveLoc in {Bad,Medium}:
##                 :...Population <= 203: No (48.6/5)
##                     Population > 203:
##                     :...CompPrice <= 109: No (8)
##                         CompPrice > 109:
##                         :...Price > 124: No (5.3)
##                             Price <= 124:
##                             :...Age <= 75: Yes (29.6/9.4)
##                                 Age > 75: No (4.5)
##
## -----  Trial 90:  -----
##
## Decision tree:
##
## Price > 135: No (56.3/11.9)
## Price <= 135:
## :...ShelveLoc = Good:
##     :...CompPrice <= 98: No (7.9/2)
##     :   CompPrice > 98: Yes (21.3)
##     ShelveLoc in {Bad,Medium}:
##     :...Income > 100: Yes (22/3.7)
##         Income <= 100:
##         :...CompPrice <= 122:
##             :...Price <= 70: Yes (5.8)
```

```
##             :    Price > 70:
##             :    :...US = No: No (27.4/1.3)
##             :        US = Yes:
##             :        :...Age <= 35: Yes (8.2/1.9)
##             :            Age > 35:
##             :            :...Price > 102: No (32.3)
##             :                Price <= 102:
##             :                :...Price <= 98: No (17.9/2)
##             :                    Price > 98: Yes (10.1/2.5)
##         CompPrice > 122:
##         :...Education <= 10: Yes (10.9/0.2)
##             Education > 10:
##             :...Price <= 104: Yes (15.5/1)
##                 Price > 104:
##                 :...CompPrice > 148: Yes (14.6/3)
##                     CompPrice <= 148:
##                     :...Population > 459: Yes (4.3)
##                         Population <= 459:
##                         :...Price > 125: No (9.3)
##                             Price <= 125:
##                             :...Advertising <= 10: No (30.4/5.7)
##                                 Advertising > 10: Yes (7.1)
##
## -----  Trial 91:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Income <= 42: No (17.2/3.5)
## :   Income > 42: Yes (36/3.2)
## ShelveLoc in {Bad,Medium}:
## :...Price <= 100:
##     :...Advertising > 7: Yes (21.5/1.7)
##     :   Advertising <= 7:
##     :   :...Price > 97: Yes (7.4)
##     :       Price <= 97:
##     :       :...Price <= 70: Yes (4.6)
##     :           Price > 70:
##     :           :...CompPrice > 125: Yes (4.4)
##     :               CompPrice <= 125:
##     :               :...Income <= 102: No (21.9/0.9)
##     :                   Income > 102: Yes (3.5)
##     Price > 100:
##     :...CompPrice <= 123: No (72.9/8.8)
##         CompPrice > 123:
##         :...Advertising > 21: Yes (7.3)
##             Advertising <= 21:
##             :...Price > 144: No (11.6)
##                 Price <= 144:
##                 :...ShelveLoc = Bad:
##                     :...Education <= 16: No (15.6/1.7)
##                     :   Education > 16: Yes (6.1/1.2)
##                     ShelveLoc = Medium:
##                     :...Age <= 33: Yes (12.9)
```

```
##                         Age > 33:
##                         :...Advertising <= 3: No (25.5/5.4)
##                             Advertising > 3: Yes (32.6/10.4)
##
## -----  Trial 92:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Urban = No:
## :   :...Price <= 133: Yes (14.7/3.6)
## :   :   Price > 133: No (7.2)
## :   Urban = Yes:
## :   :...Price <= 156: Yes (32.3/1.9)
## :       Price > 156: No (3.5)
## ShelveLoc in {Bad,Medium}:
## :...ShelveLoc = Bad:
##     :...Urban = No: No (16.2/2.8)
##     :   Urban = Yes:
##     :   :...Age > 59: No (17.2/2.2)
##     :       Age <= 59:
##     :       :...Education > 17: Yes (2.7)
##     :           Education <= 17:
##     :           :...Price <= 124: Yes (20.4/6.6)
##     :               Price > 124: No (8.2)
##     ShelveLoc = Medium:
##     :...Price <= 90: Yes (16.2/2)
##         Price > 90:
##         :...Age > 49:
##             :...CompPrice > 140: Yes (18.5/5.6)
##             :   CompPrice <= 140:
##             :   :...Price > 127: No (17.6)
##             :       Price <= 127:
##             :       :...Income <= 112: No (57.9/15.7)
##             :           Income > 112: Yes (3.9)
##             Age <= 49:
##             :...Education > 17: No (5.9/0.3)
##                 Education <= 17:
##                 :...Advertising > 10: Yes (19.5/1.3)
##                     Advertising <= 10:
##                     :...CompPrice <= 115: No (7.8)
##                         CompPrice > 115:
##                         :...Price <= 140: Yes (24.5/3.8)
##                             Price > 140: No (6.9)
##
## -----  Trial 93:  -----
##
## Decision tree:
##
## Price <= 104:
## :...ShelveLoc = Good: Yes (11.8)
## :   ShelveLoc in {Bad,Medium}:
## :   :...CompPrice > 118: Yes (32.5/2.6)
## :       CompPrice <= 118:
```

```
## :           :...Income <= 53: No (19.5/1.4)
## :               Income > 53:
## :               :...Urban = No: Yes (11.8)
## :                   Urban = Yes:
## :                   :...CompPrice <= 116: Yes (25.9/8)
## :                       CompPrice > 116: No (5.9)
## Price > 104:
## :...CompPrice <= 114: No (27.6/2.5)
##     CompPrice > 114:
##     :...ShelveLoc = Good:
##         :...Age <= 73: Yes (20.1/1.5)
##         :   Age > 73: No (4.9)
##         ShelveLoc in {Bad,Medium}:
##         :...Advertising > 13: Yes (26.2/7.6)
##             Advertising <= 13:
##             :...Price > 144: No (12.4)
##                 Price <= 144:
##                 :...CompPrice > 142: Yes (26.2/8.6)
##                     CompPrice <= 142:
##                     :...Price > 125: No (21.2)
##                         Price <= 125:
##                         :...Advertising > 10: Yes (6.3)
##                             Advertising <= 10:
##                             :...ShelveLoc = Bad: No (12.4)
##                                 ShelveLoc = Medium:
##                                 :...Price <= 111: No (8.6)
##                                     Price > 111:
##                                     :...Advertising <= 3: No (20.2/8.2)
##                                         Advertising > 3: Yes (7.4/0.8)
##
## -----  Trial 94:  -----
##
## Decision tree:
##
## ShelveLoc = Good:
## :...Price <= 135: Yes (32.3/3.8)
## :   Price > 135: No (19.4/7)
## ShelveLoc in {Bad,Medium}:
## :...Price > 126:
##     :...Advertising <= 23: No (68.6/9)
##     :   Advertising > 23: Yes (4.1)
##     Price <= 126:
##     :...CompPrice > 123:
##         :...Advertising > 10: Yes (14.5)
##         :   Advertising <= 10:
##         :   :...Age <= 74: Yes (46.9/12.5)
##         :       Age > 74: No (3.4)
##         CompPrice <= 123:
##         :...Urban = Yes:
##             :...Price <= 81: Yes (11.8/2.5)
##             :   Price > 81: No (70.6/13.4)
##             Urban = No:
##             :...Income <= 48: No (6.7)
##                 Income > 48:
```

```
##                     :...Price <= 105: Yes (15.8)
##                         Price > 105: No (6.9/2.3)
##
## -----  Trial 95:  -----
##
## Decision tree:
##
## ShelveLoc = Bad:
## :...Income <= 98: No (57.5/11.9)
## :   Income > 98: Yes (15.3/4.6)
## ShelveLoc = Good:
## :...Price <= 156: Yes (46.6/10.6)
## :   Price > 156: No (4.4)
## ShelveLoc = Medium:
## :...Age <= 33: Yes (25.4/4.4)
##     Age > 33:
##     :...Price <= 104:
##         :...Advertising > 6: Yes (22.9/0.5)
##         :   Advertising <= 6:
##         :   :...CompPrice <= 122: No (26.6/10)
##         :       CompPrice > 122: Yes (4.9)
##         Price > 104:
##         :...Population <= 189: No (32.6/2.7)
##             Population > 189:
##             :...CompPrice > 142: Yes (15/0.5)
##                 CompPrice <= 142:
##                 :...Price > 127: No (17.9)
##                     Price <= 127:
##                     :...Income > 97: Yes (6.5)
##                         Income <= 97:
##                         :...Population <= 469: No (20.5/4.4)
##                             Population > 469: Yes (4.8/0.5)
##
## -----  Trial 96:  -----
##
## Decision tree:
##
## Price <= 101:
## :...Advertising > 7: Yes (26.7/1.6)
## :   Advertising <= 7:
## :   :...Urban = No: Yes (12.1/1)
## :       Urban = Yes:
## :       :...Age > 67: No (6.1)
## :           Age <= 67:
## :           :...Advertising <= 3: Yes (30.9/6.5)
## :               Advertising > 3: No (8.9/1.8)
## Price > 101:
## :...Advertising <= 2:
##     :...CompPrice <= 131: No (44.6/4.3)
##     :   CompPrice > 131:
##     :   :...Age <= 38: Yes (8.6/0.2)
##     :       Age > 38: No (23.4/8.3)
##     Advertising > 2:
##     :...US = No: Yes (13.6/2.8)
```

```
##          US = Yes:
##          :...ShelveLoc = Good: Yes (19.9/4.6)
##              ShelveLoc in {Bad,Medium}:
##              :...Age <= 49:
##                  :...CompPrice <= 157: Yes (43.1/13.3)
##                  :   CompPrice > 157: No (2.8)
##                  Age > 49:
##                  :...Advertising <= 9: No (18.2)
##                      Advertising > 9:
##                      :...Price <= 127: Yes (26.5/11.7)
##                          Price > 127: No (15.6/0.9)
##
## -----  Trial 97:  -----
##
## Decision tree:
##
## Price <= 100:
## :...Price > 97: Yes (14.1)
## :   Price <= 97:
## :   :...ShelveLoc = Good: Yes (5.5)
## :       ShelveLoc in {Bad,Medium}:
## :       :...Price <= 70: Yes (7.7)
## :           Price > 70:
## :           :...CompPrice > 123: Yes (8)
## :               CompPrice <= 123:
## :               :...Advertising > 7: Yes (14.2/2.9)
## :                   Advertising <= 7:
## :                   :...Income <= 102: No (22.3/1.6)
## :                       Income > 102: Yes (2.3)
## Price > 100:
## :...CompPrice > 142:
##     :...Urban = No: No (9.5/2.3)
##     :   Urban = Yes: Yes (37.6/8.8)
##     CompPrice <= 142:
##     :...ShelveLoc = Bad: No (41/5.6)
##         ShelveLoc = Good:
##         :...CompPrice <= 100: No (4.9)
##         :   CompPrice > 100:
##         :   :...Price <= 135: Yes (15.8)
##         :       Price > 135: No (14.3/3.4)
##         ShelveLoc = Medium:
##         :...Price > 127: No (25.8/2.2)
##             Price <= 127:
##             :...CompPrice <= 122:
##                 :...US = No: No (12.2)
##                 :   US = Yes:
##                 :   :...Income <= 102: No (24.6/5.4)
##                 :       Income > 102: Yes (4)
##                 CompPrice > 122:
##                 :...Advertising > 10: Yes (11.5)
##                     Advertising <= 10:
##                     :...US = No: Yes (18.6/7.1)
##                         US = Yes: No (7.2/0.8)
##
```

```
## -----  Trial 98:  -----
##
## Decision tree:
##
## Age > 73:
## :...Education > 17: Yes (4.4/0.4)
## :   Education <= 17:
## :   :...Price <= 84: Yes (2.6)
## :       Price > 84: No (36.8/1.7)
## Age <= 73:
## :...Price <= 104:
##     :...Advertising > 7: Yes (27.2/1.7)
##     :   Advertising <= 7:
##     :   :...CompPrice > 121: Yes (9.6)
##     :       CompPrice <= 121:
##     :       :...Price <= 70: Yes (6.8)
##     :           Price > 70: No (32/13)
##     Price > 104:
##     :...ShelveLoc = Good:
##         :...Income <= 41: No (14.9/4)
##         :   Income > 41: Yes (22.7/1.7)
##         ShelveLoc in {Bad,Medium}:
##         :...Education <= 10: Yes (13.4/2.8)
##             Education > 10:
##             :...Advertising > 20: Yes (7.1)
##                 Advertising <= 20:
##                 :...Price > 129: No (35.7/1.2)
##                     Price <= 129:
##                     :...Price <= 111: No (13.6/0.2)
##                         Price > 111:
##                         :...Price <= 115: Yes (8.5/0.4)
##                             Price > 115:
##                             :...CompPrice <= 121: No (12.5)
##                                 CompPrice > 121:
##                                 :...Advertising > 10: Yes (12.1/2)
##                                     Advertising <= 10:
##                                     :...Population > 402: Yes (4.7)
##                                         Population <= 402:
##                                         :...Age > 71: Yes (2.5)
##                                             Age <= 71:
##                                             :...Advertising > 4: No (7.6)
##                                                 Advertising <= 4:
##                                                 :...CompPrice > 146: Yes (4.6)
##                                                     CompPrice <= 146:
##                                                     :...Age <= 33: Yes (4.2/1.2)
##                                                         Age > 33: No (17.5)
##
## -----  Trial 99:  -----
##
## Decision tree:
##
## Price <= 105:
## :...ShelveLoc = Good: Yes (13.3)
## :   ShelveLoc in {Bad,Medium}:
```

```
## :     :...Age > 73: No (12.6/2)
## :         Age <= 73:
## :         :...Urban = No: Yes (24/1.9)
## :             Urban = Yes:
## :             :...Advertising > 19: No (3.5)
## :                 Advertising <= 19:
## :                 :...Advertising <= 0: No (15.9/6.1)
## :                     Advertising > 0: Yes (34.1/4.8)
## Price > 105:
## :...ShelveLoc = Good:
##     :...Price > 156: No (5.9)
##     :   Price <= 156:
##     :   :...Urban = No: No (13.8/4.8)
##     :       Urban = Yes: Yes (25.6/1.5)
##     ShelveLoc in {Bad,Medium}:
##     :...Urban = No:
##         :...Income <= 94: No (34.3/2)
##         :   Income > 94: Yes (10.6/3.9)
##         Urban = Yes:
##         :...Advertising > 21: Yes (5.5)
##             Advertising <= 21:
##             :...Price > 139: No (18.1)
##                 Price <= 139:
##                 :...CompPrice <= 121: No (21.8/2.8)
##                     CompPrice > 121:
##                     :...Education <= 10: Yes (8.2)
##                         Education > 10:
##                         :...ShelveLoc = Bad:
##                             :...Education <= 16: No (21/4.6)
##                             :   Education > 16: Yes (5.2/0.9)
##                             ShelveLoc = Medium:
##                             :...CompPrice <= 141: No (21.8/8.1)
##                                 CompPrice > 141: Yes (5.8)
##
##
## Evaluation on training data (301 cases):
##
## Trial        Decision Tree
## -----        ----------------
##    Size        Errors
##
##    0    19   19( 6.3%)
##    1    12   52(17.3%)
##    2    18   39(13.0%)
##    3    15   50(16.6%)
##    4    17   54(17.9%)
##    5    15   36(12.0%)
##    6    13   64(21.3%)
##    7    14   49(16.3%)
##    8    23   36(12.0%)
##    9    14   52(17.3%)
##   10    13   57(18.9%)
##   11    17   41(13.6%)
##   12    13   73(24.3%)
```

```
##   13     17     37(12.3%)
##   14     18     47(15.6%)
##   15     17     46(15.3%)
##   16     16     57(18.9%)
##   17     15     25( 8.3%)
##   18     15     56(18.6%)
##   19     19     39(13.0%)
##   20     18     40(13.3%)
##   21     17     45(15.0%)
##   22     17     43(14.3%)
##   23     19     37(12.3%)
##   24     15     35(11.6%)
##   25     19     27( 9.0%)
##   26     14     70(23.3%)
##   27     14     40(13.3%)
##   28     19     61(20.3%)
##   29     15     33(11.0%)
##   30     14     52(17.3%)
##   31     15     46(15.3%)
##   32     15     46(15.3%)
##   33     17     49(16.3%)
##   34     14     57(18.9%)
##   35     15     34(11.3%)
##   36     13     61(20.3%)
##   37     15     61(20.3%)
##   38     15     51(16.9%)
##   39     11     44(14.6%)
##   40     19     32(10.6%)
##   41     21     42(14.0%)
##   42     13     59(19.6%)
##   43     21     40(13.3%)
##   44     14     43(14.3%)
##   45     16     43(14.3%)
##   46     18     52(17.3%)
##   47     16     46(15.3%)
##   48     20     47(15.6%)
##   49     16     41(13.6%)
##   50     17     54(17.9%)
##   51      8     48(15.9%)
##   52     14     59(19.6%)
##   53     17     46(15.3%)
##   54     16     43(14.3%)
##   55     14     46(15.3%)
##   56     12     50(16.6%)
##   57     20     38(12.6%)
##   58     19     64(21.3%)
##   59     22     49(16.3%)
##   60     14     44(14.6%)
##   61      9     58(19.3%)
##   62     17     55(18.3%)
##   63     16     53(17.6%)
##   64     18     32(10.6%)
##   65     11     65(21.6%)
##   66     18     43(14.3%)
```

```
##   67       16    54(17.9%)
##   68       16    39(13.0%)
##   69       19    56(18.6%)
##   70       17    34(11.3%)
##   71       17    47(15.6%)
##   72       19    45(15.0%)
##   73       17    49(16.3%)
##   74       17    37(12.3%)
##   75       18    33(11.0%)
##   76       12    54(17.9%)
##   77       21    42(14.0%)
##   78       14    47(15.6%)
##   79       13    62(20.6%)
##   80       13    54(17.9%)
##   81       17    50(16.6%)
##   82       18    30(10.0%)
##   83       16    48(15.9%)
##   84       14    52(17.3%)
##   85       15    34(11.3%)
##   86       20    40(13.3%)
##   87       18    43(14.3%)
##   88       15    36(12.0%)
##   89       15    39(13.0%)
##   90       17    33(11.0%)
##   91       16    51(16.9%)
##   92       19    44(14.6%)
##   93       18    37(12.3%)
##   94       12    40(13.3%)
##   95       14    51(16.9%)
##   96       15    69(22.9%)
##   97       20    32(10.6%)
##   98       22    35(11.6%)
##   99       19    52(17.3%)
## boost            0( 0.0%)   <<
##
##
##     (a)    (b)     <-classified as
##     ----   ----
##    151            (a): class No
##           150     (b): class Yes
##
##
##  Attribute usage:
##
##  100.00% CompPrice
##  100.00% Income
##  100.00% Advertising
##  100.00% Population
##  100.00% Price
##  100.00% ShelveLoc
##  100.00% Age
##  100.00% Education
##  100.00% Urban
##   94.35% US
```

```
##
##
## Time: 0.2 secs
```

La técnica de boosting hace que en el conjunto de entrenamiento, la tase de errores se reduzca a 0.

Volvemos a realizar la predicción:

```
#Prediction

sales_pred_boost100 <- predict(sales_model_boost100, CarseatsNew_test)
```

Y comparamos lo predicho por el algoritmo con los datos etiquetados anteriormente

```
#confusion matrix
confusionMatrix(reference = CarseatsNew_test_labels, data = sales_pred_boost100, mode = "everything", p
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction No Yes
##        No  43  15
##        Yes  7  34
##
##               Accuracy : 0.7778
##                 95% CI : (0.6831, 0.8552)
##    No Information Rate : 0.5051
##    P-Value [Acc > NIR] : 2.178e-08
##
##                  Kappa : 0.5548
##
##  Mcnemar's Test P-Value : 0.1356
##
##            Sensitivity : 0.6939
##            Specificity : 0.8600
##         Pos Pred Value : 0.8293
##         Neg Pred Value : 0.7414
##              Precision : 0.8293
##                 Recall : 0.6939
##                     F1 : 0.7556
##             Prevalence : 0.4949
##         Detection Rate : 0.3434
##   Detection Prevalence : 0.4141
##      Balanced Accuracy : 0.7769
##
##        'Positive' Class : Yes
##
```

La mejora obtenida es mínima con 10 iteraciones, pero con 100 es algo más.

Sin boosting se obtuvo:

```
    Reference
```

Prediction No Yes No 41 16 Yes 9 33

Accuracy : 0.7475

Con boosting - 10 iteracciones:

```
        Reference
```

Prediction No Yes No 40 14 Yes 10 35

Accuracy : 0.7576

Con boosting - 100 iteracciones:

```
        Reference
```

Prediction No Yes No 43 15 Yes 7 34

Accuracy : 0.7778

Posibles soluciones: entrenar el modelo con un conjunto más grande de datos. No parece que un conjunto de datos de solo 400 muestras sea suficiente para obtener unos resultados aceptables.