StatR 301: Spring 2013

Homework 02

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bicreg versus bic.glm

Preparatory work:

```
autos = read.csv("autoMPGtrain.csv", as.is = TRUE)

autos$gp100m = 100/autos$mpg
autos$continent = factor(autos$continent)
autos$name = tolower(autos$name)
autos$diesel = grepl("diesel", autos$name)
autos$diesel[autos$name == "mercedes-benz 240d"] = TRUE
autos$wagon = grepl("[(]sw[)]", autos$name)
autos$cylgroup = cut(autos$cyl, c(2, 5.5, 6.5, 9))

# str(autos)

library(BMA)
```

bicreg invocation

```
> bma1 = bicreg(autos[, c(3:8, 11:13)], autos$gp100m)
> round(bma1$postprob, 2)
 [1] 0.24 0.23 0.15 0.10 0.04 0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.02
0.01 0.01 0.01 0.01 0.01 0.01
```

bic.glm invocation

```
> formula = as.formula("gp100m ~ volume + hp + weight + accel + year +
continent + diesel + wagon + cylgroup")
> bma2 = bic.glm(f=formula, data=autos, glm.family=gaussian())
> round(bma2$postprob, 2)
 [1] 0.40 0.35 0.07 0.03 0.03 0.03 0.02 0.02 0.02 0.02
```

The “postprob” field is the posterior probability – the probability of the parameter(s) given the evidence. In this case, it is the probability of the parameter in the model.

Comparison of the postprob results (posterior probability) shows that the bic.glm is the more aggressive of the two functions.

Model comparisons

The two functions do not identify the same models in the same order. Here are the two results:

bicreg model results

Volume	hp	weight	accel	year	continent2	continent3	dieselTRUE	wagonTRUE	cylgroup.5.5.6.5.	cylgroup.6.5.9.
F	T	T	T	T	F	F	T	F	F	F
F	T	T	F	T	F	F	T	F	F	F
F	T	T	T	T	F	F	T	F	T	F
F	T	T	F	T	F	F	T	F	T	F
F	T	T	T	T	F	F	T	F	T	T
F	T	T	T	T	F	T	T	F	F	F
F	T	T	F	T	F	T	T	F	F	F
F	F	T	F	T	F	F	T	F	F	F
F	T	T	T	T	F	F	T	T	F	F
F	T	T	F	T	F	F	T	T	F	F

bic.glm model results

Volume	hp	weight	accel	year	continent	diesel	wagon	cylgroup
F	T	T	T	T	F	T	F	F
F	T	T	F	T	F	T	F	F
F	T	T	T	T	F	T	F	T
F	T	T	T	T	F	T	T	F
F	T	T	F	T	F	T	T	F
T	T	T	T	T	F	T	F	T
F	T	T	F	T	F	T	F	T
T	T	T	T	T	F	T	F	F
T	T	T	F	T	F	T	F	F
F	F	T	F	T	F	T	F	F

bicreg versus bic.glm: argument comparison

To solve this, I copied the bicreg arguments and bic.glm arguments into Excel columns, then did a VLOOKUP to match. The only bicreg argument that is not matched by a bic.glm argument is drop.factor.levels. It was nice of them to make the argument names match.

bicreg argument	Matching bic.glm argument
x	x
y	y
wt	wt
strict	strict
OR	OR
maxCol	maxCol
drop.factor.levels	missing
nbest	nbest

The default parameters are very similar, with only slight differences for maxCol and nbest:

```
# From help vignette...
# bic.glm(f, data, glm.family, wt = rep(1, nrow(data)), strict = FALSE,
#         prior.param = c(rep(0.5, ncol(data))), OR = 20, maxCol = 30, OR.fix = 2,
#         nbest = 150, dispersion = , factor.type = TRUE,
#         factor.prior.adjust = FALSE, occam.window = TRUE, ...)

# From help vignette...
# bicreg(x, y, wt = rep(1, length(y)), strict = FALSE, OR = 20, maxCol = 31,
#      drop.factor.levels = TRUE, nbest = 10)
```

However, even with identical arguments, the results are not equivalent.

Cross-validation on test set

Cross-validate core function:

```
# crossValidate.bic.glm.r
library(BMA)

crossValidate.bic.glm <- function(ds, formula, nSets, OR.value, use.OR=TRUE,
yvalue) {
  strDesc = sprintf("model=bic.glm, OR=%d, use.OR=%s", OR.value, use.OR)
  nRows = length(ds[,1])
  nRowsPerSet = floor(nRows / nSets)

  # Accumulate the total test error.
  total.test.err = 0

  # Iterate through the data set, dividing into test and training data sets.)
  for (nSet in 1:nSets) {
      # Identify the test set indices.
      idxFirst = ((nSet - 1) * nRowsPerSet + 1)
      idxLast = nSet * nRowsPerSet

      # Don't read past the end of the data.
      idxLast = ifelse(idxLast > nRows, nRows, idxLast)
      idxSetTest = idxFirst:idxLast

      # The training set is everything but the test set.
      idxSetTrain = setdiff(1:nRows, idxSetTest)

      # Select data for training, testing.
      train = ds[idxSetTrain, ]
      test = ds[idxSetTest, ]

      # Create the model for this training set.
      model = bic.glm(formula, glm.family=gaussian(), data=train,
OR=OR.value)

      # Calculate rms error for this test set.
      test.yhat <- predict(object=model, newdata=test)
    test.y <- with(test, get(yvalue))
    test.err <- sqrt(mean((test.yhat - test.y)^2))

    # Accumulate test error * size of test set.
      total.test.err = total.test.err + test.err
  }

  mean.test.err = total.test.err / nSets

  # Return a dataframe of result information.
  result <- data.frame(description=strDesc, rms.error=mean.test.err)

  result
}
```

Cross-validation outer function:

```
source("crossValidate.bic.glm.r")

# General cross-validation function
crossValidate <- function(ds, formula, nSets=5, yvalue) {
  nSets <- ifelse(nSets == 0, 10, nSets) # no divide by zero...

  # Create an empty dataframe to store results.
  results <- data.frame(description=character(), rms.error=numeric())

  # Cross-validate bic.glm (Bayesian Model Averaging).
  for ( OR.value in c(5, 10, 20, 50, 100) ) {
      result <-crossValidate.bic.glm(ds, formula, nSets, OR.value, TRUE,
yvalue)
```

```
      results <- rbind(results, result)
  }

  result <-crossValidate.bic.glm(ds, formula, nSets, 20, FALSE, yvalue)
  results <- rbind(results, result)

  # Return results dataframe
  results
}
```

Cross-validation results (test set)

Description	rms.error
model=bic.glm, OR=5, use.OR=TRUE	0.6126412
model=bic.glm, OR=10, use.OR=TRUE	0.6099908
model=bic.glm, OR=20, use.OR=TRUE	0.6097193
model=bic.glm, OR=50, use.OR=TRUE	0.6084349
model=bic.glm, OR=100, use.OR=TRUE	0.6081755
model=bic.glm, OR=20, use.OR=FALSE	0.6097193

Models selected with OR = 100

```
# > formula
gp100m ~ volume + hp + weight + accel + year + continent + diesel +  wagon + cylgroup

# > model$which
    # [,1]  [,2] [,3]  [,4] [,5]  [,6] [,7]  [,8]  [,9]
# [1,] FALSE  TRUE TRUE  TRUE TRUE FALSE TRUE FALSE FALSE
# [2,] FALSE  TRUE TRUE FALSE TRUE FALSE TRUE FALSE FALSE
# [3,] FALSE  TRUE TRUE  TRUE TRUE FALSE TRUE FALSE  TRUE
# [4,] FALSE  TRUE TRUE  TRUE TRUE FALSE TRUE  TRUE FALSE
# [5,] FALSE  TRUE TRUE FALSE TRUE FALSE TRUE  TRUE FALSE
# [6,]  TRUE  TRUE TRUE  TRUE TRUE FALSE TRUE FALSE  TRUE
```

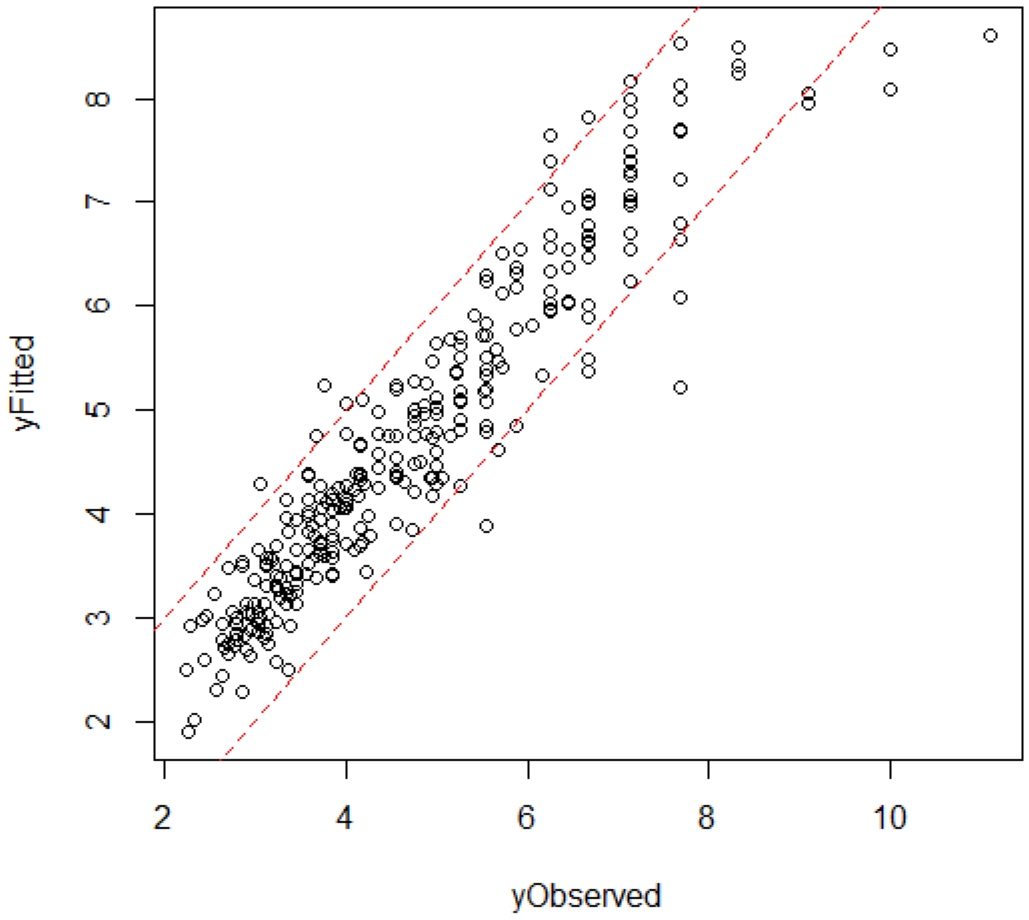
Function plotFit

```
plotFit <- function(yObserved, yFitted, intercept=1) {
  plot(yObserved, yFitted)
  abline(intercept,1,lty=2, col=rgb(1,0,0))
  abline(-intercept,1,lty=2, col=rgb(1,0,0))
}
```

Results of formula selected (on training set)

```
formula.1 = as.formula("gp100m ~ hp + weight + accel + year + diesel" )
```

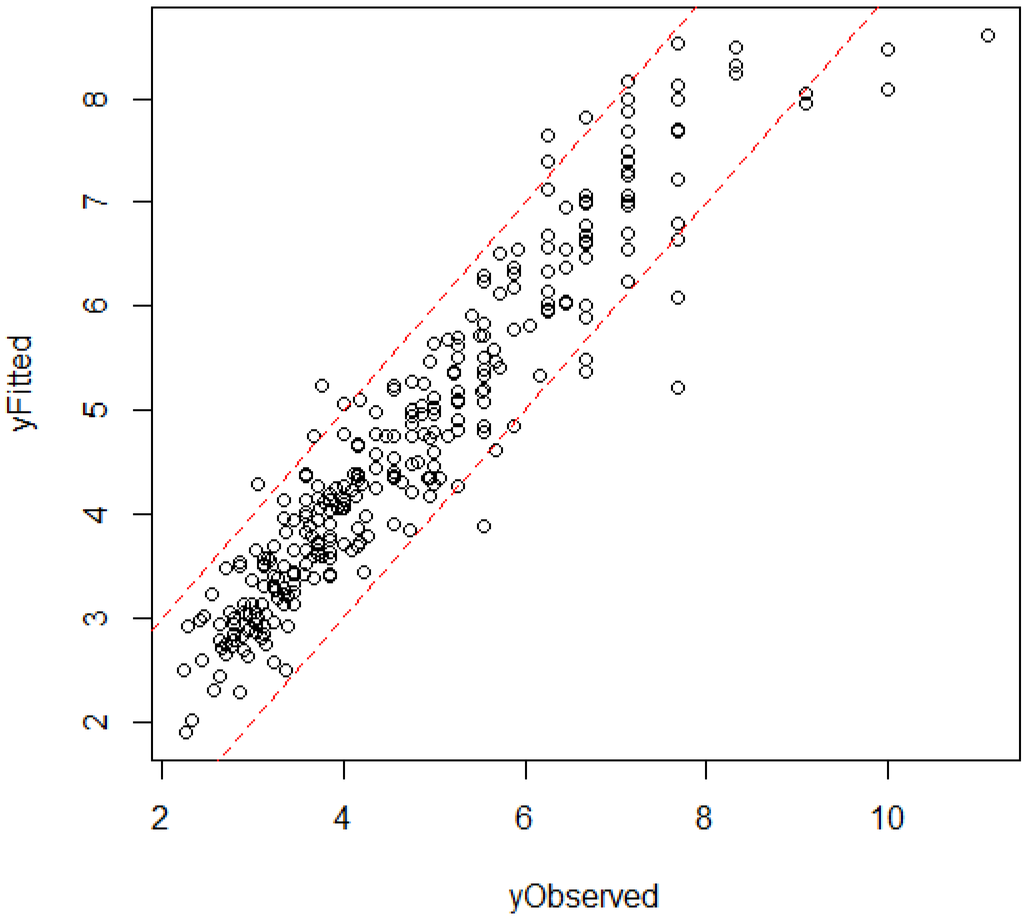
```
model.1 = lm(formula=formula.1, data=autos.clean)
plotFit(autos.clean$gp100m, fitted(model.1))
```



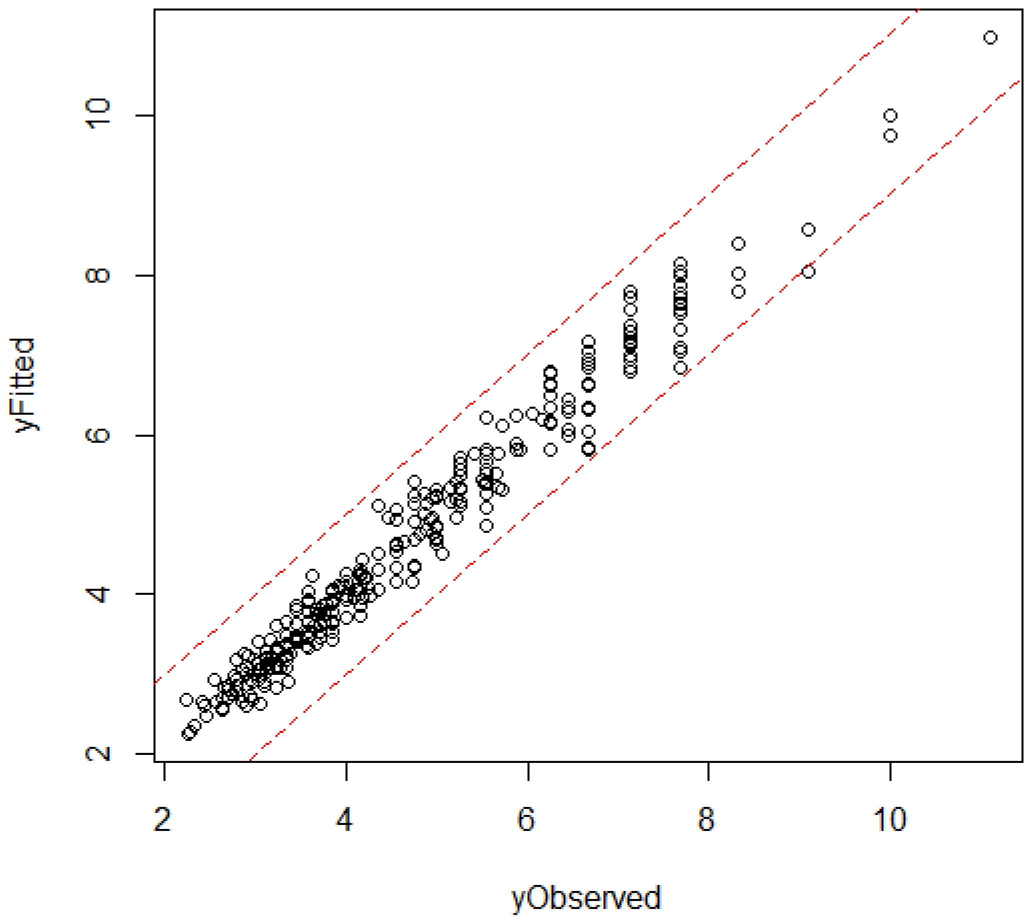
Note: This is not as good as the fit I got during "the homework from hell".

Fit model to test dataset

```
autos.test = read.csv("autoMPGtest.csv", as.is = TRUE)

autos.test$gp100m = 100/autos.test$mpg
autos.test$continent = factor(autos.test$continent)
autos.test$name = tolower(autos.test$name)
autos.test$diesel = grepl("diesel", autos.test$name)
autos.test$diesel[autos.test$name == "mercedes-benz 240d"] = TRUE
autos.test$wagon = grepl("[(]sw[)]", autos.test$name)
autos.test$cylgroup = cut(autos.test$cyl, c(2, 5.5, 6.5, 9))

autos.test.clean = autos.test[, (colnames(autos) %in% c("volume", "hp", "weight", "accel", "year",
"continent", "gp100m", "diesel", "wagon", "cylgroup") ) ]

formula.1 = as.formula("gp100m ~ hp + weight + accel + year + diesel" )
model.test = lm(formula=formula.1, data=autos.clean)

plotFit(autos.clean$gp100m, fitted(model.test))
```



For what it's worth, this is the fit I got in HWFH. The lines are at 0.7 and not 1.0 in the case below.


yFitted
yObserved
2
4
6
8
10
2
4
6
8
10

Code from homework:

Hw02.r

```
setwd("C:/Users/Rod/SkyDrive/R/301/Week03")
autos = read.csv("autoMPGtrain.csv", as.is = TRUE)

autos$gp100m = 100/autos$mpg
autos$continent = factor(autos$continent)
autos$name = tolower(autos$name)
autos$diesel = grepl("diesel", autos$name)
autos$diesel[autos$name == "mercedes-benz 240d"] = TRUE
autos$wagon = grepl("[(]sw[)]", autos$name)
autos$cylgroup = cut(autos$cyl, c(2, 5.5, 6.5, 9))

str(autos)

library(BMA)
# ?bic.glm

# From class code...
options(width = 132)
bma1 = bicreg(autos[, c(3:8, 11:13)], autos$gp100m)
round(bma1$postprob, 2)

autos.clean = autos[, (colnames(autos) %in% c("volume", "hp", "weight", "accel", "year", "continent",
"gp100m", "diesel", "wagon", "cylgroup") ) ]

# From help vignette...
#bic.glm(f, data, glm.family, wt = rep(1, nrow(data)), strict = FALSE,
#         prior.param = c(rep(0.5, ncol(x))), OR = 20, maxCol = 30, OR.fix = 2,
#         nbest = 150, dispersion = , factor.type = TRUE,
#         factor.prior.adjust = FALSE, occam.window = TRUE, ...)

# From help vignette...
# bicreg(x, y, wt = rep(1, length(y)), strict = FALSE, OR = 20, maxCol = 31,
#     drop.factor.levels = TRUE, nbest = 10)


bma1 = bicreg(autos[, c(3:8, 11:13)], autos$gp100m)
formula = as.formula("gp100m ~ volume + hp + weight + accel + year + continent + diesel + wagon +
cylgroup")
bma2 = bic.glm(f = formula, data = autos, glm.family=gaussian())
```

```
round(bma1$postprob, 2)
round(bma2$postprob, 2)
bma1$which
bma2$which


# From help vignette...
# bic.glm(f, data, glm.family, wt = rep(1, nrow(data)), strict = FALSE,
#           prior.param = c(rep(0.5, ncol(data))), OR = 20, maxCol = 30, OR.fix = 2,
#           nbest = 150, dispersion = , factor.type = TRUE,
#           factor.prior.adjust = FALSE, occam.window = TRUE, ...)

# From help vignette...
# bicreg(x, y, wt = rep(1, length(y)), strict = FALSE, OR = 20, maxCol = 31,
#      drop.factor.levels = TRUE, nbest = 10)


# Cross-validation (part c)===================================================

 plotFit <- function(yObserved, yFitted, intercept=1) {
  plot(yObserved, yFitted)
  abline(intercept,1,lty=2, col=rgb(1,0,0))
  abline(-intercept,1,lty=2, col=rgb(1,0,0))
}

autos = read.csv("autoMPGtrain.csv", as.is = TRUE)

autos$gp100m = 100/autos$mpg
autos$continent = factor(autos$continent)
autos$name = tolower(autos$name)
autos$diesel = grepl("diesel", autos$name)
autos$diesel[autos$name == "mercedes-benz 240d"] = TRUE
autos$wagon = grepl("[(]sw[)]", autos$name)
autos$cylgroup = cut(autos$cyl, c(2, 5.5, 6.5, 9))

autos.clean = autos[, (colnames(autos) %in% c("volume", "hp", "weight", "accel", "year", "continent",
"gp100m", "diesel", "wagon", "cylgroup") ) ]

formula = as.formula("gp100m ~ volume + hp + weight + accel + year + continent + diesel + wagon +
cylgroup")
source("crossValidate.r")
result = crossValidate(autos.clean, formula, nSets=5, "gp100m")
```

```
# Best result came with OR=100
# Create the model for this training set.
> model = bic.glm(formula, glm.family=gaussian(), data=autos.clean, OR=100)
# > model$which
     # [,1]  [,2] [,3]  [,4] [,5]  [,6] [,7]  [,8]  [,9]
# [1,] FALSE  TRUE TRUE  TRUE TRUE FALSE TRUE FALSE FALSE
# [2,] FALSE  TRUE TRUE FALSE TRUE FALSE TRUE FALSE FALSE
# [3,] FALSE  TRUE TRUE  TRUE TRUE FALSE TRUE FALSE  TRUE
# [4,] FALSE  TRUE TRUE  TRUE TRUE FALSE TRUE  TRUE FALSE
# [5,] FALSE  TRUE TRUE FALSE TRUE FALSE TRUE  TRUE FALSE
# [6,]  TRUE  TRUE TRUE  TRUE TRUE FALSE TRUE FALSE  TRUE
# [7,] FALSE  TRUE TRUE FALSE TRUE FALSE TRUE FALSE  TRUE
# [8,]  TRUE  TRUE TRUE  TRUE TRUE FALSE TRUE FALSE FALSE
 # [9,]  TRUE  TRUE TRUE FALSE TRUE FALSE TRUE FALSE FALSE
# [10,] FALSE FALSE TRUE FALSE TRUE FALSE TRUE FALSE FALSE
# [11,]  TRUE  TRUE TRUE FALSE TRUE FALSE TRUE FALSE  TRUE
# [12,] FALSE  TRUE TRUE  TRUE TRUE  TRUE TRUE FALSE FALSE
# [13,] FALSE  TRUE TRUE  TRUE TRUE FALSE TRUE  TRUE  TRUE
# > formula
# gp100m ~ volume + hp + weight + accel + year + continent + diesel +
   # wagon + cylgroup

formula.1 = as.formula("gp100m ~ hp + weight + accel + year + diesel" )
model.1 = lm(formula=formula.1, data=autos.clean)

plotFit(autos.clean$gp100m, fitted(model.1))

autos.test = read.csv("autoMPGtest.csv", as.is = TRUE)

autos.test$gp100m = 100/autos.test$mpg
autos.test$continent = factor(autos.test$continent)
autos.test$name = tolower(autos.test$name)
autos.test$diesel = grepl("diesel", autos.test$name)
autos.test$diesel[autos.test$name == "mercedes-benz 240d"] = TRUE
autos.test$wagon = grepl("[(]sw[)]", autos.test$name)
autos.test$cylgroup = cut(autos.test$cyl, c(2, 5.5, 6.5, 9))

autos.test.clean = autos.test[, (colnames(autos) %in% c("volume", "hp", "weight", "accel", "year",
"continent", "gp100m", "diesel", "wagon", "cylgroup") ) ]

formula.1 = as.formula("gp100m ~ hp + weight + accel + year + diesel" )
```

```
model.test = lm(formula=formula.1, data=autos.clean)

plotFit(autos.clean$gp100m, fitted(model.test))
```

crossValidate.bic.glm.r

```
# crossValidate.bic.glm.r
library(BMA)

crossValidate.bic.glm <- function(ds, formula, nSets, OR.value, use.OR=TRUE, yvalue) {
  strDesc = sprintf("model=bic.glm, OR=%d, use.OR=%s", OR.value, use.OR)
  nRows = length(ds[,1])
  nRowsPerSet = floor(nRows / nSets)

  # Accumulate the total test error.
  total.test.err = 0

  # Iterate through the data set, dividing into test and training data sets.)
  for (nSet in 1:nSets) {
            # Identify the test set indices.
            idxFirst = ((nSet - 1) * nRowsPerSet + 1)
            idxLast = nSet * nRowsPerSet

            # Don't read past the end of the data.
            idxLast = ifelse(idxLast > nRows, nRows, idxLast)
            idxSetTest = idxFirst:idxLast

            # The training set is everything but the test set.
            idxSetTrain = setdiff(1:nRows, idxSetTest)

            # Select data for training, testing.
            train = ds[idxSetTrain, ]
            test = ds[idxSetTest, ]

            # Create the model for this training set.
            model = bic.glm(formula, glm.family=gaussian(), data=train, OR=OR.value)

            # Calculate rms error for this test set.
            test.yhat <- predict(object=model, newdata=test)
    test.y <- with(test, get(yvalue))
    test.err <- sqrt(mean((test.yhat - test.y)^2))
```

```
   # Accumulate test error * size of test set.
          total.test.err = total.test.err + test.err
  }

  mean.test.err = total.test.err / nSets

  # Return a dataframe of result information.
  result <- data.frame(description=strDesc, rms.error=mean.test.err)

  result
}
```

crossValidate.r

```
source("crossValidate.bic.glm.r")

# General cross-validation function
crossValidate <- function(ds, formula, nSets=5, yvalue) {
  nSets <- ifelse(nSets == 0, 10, nSets) # no divide by zero...

  # Create an empty dataframe to store results.
  results <- data.frame(description=character(), rms.error=numeric())

  # Cross-validate bic.glm (Bayesian Model Averaging).
  for ( OR.value in c(5, 10, 20, 50, 100) ) {
          result <-crossValidate.bic.glm(ds, formula, nSets, OR.value, TRUE, yvalue)
          results <- rbind(results, result)
  }

  result <-crossValidate.bic.glm(ds, formula, nSets, 20, FALSE, yvalue)
  results <- rbind(results, result)

  # Return results dataframe
  results
}
```