VariableSelection-HittersData

SP

28/10/2019

```
library(car)
```

```
## Loading required package: carData
```

```
library(MASS)
library(LEAP)
```

```
## Warning: package 'LEAP' was built under R version 3.6.1
```

```
library(dplyr)
```

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

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

```
## The following object is masked from 'package:car':
##
##     recode
```

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

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

```
library(leaps)
```

```
## Warning: package 'leaps' was built under R version 3.6.1
```

```
library(ISLR)
```

```
## Warning: package 'ISLR' was built under R version 3.6.1
```

```
ds<-read.csv("Hitters.csv")
head(ds)
```

```
##   AtBat Hits HmRun Runs RBI Walks Years CatBat CHit CHmRun CRun CRBI
## 1   293   66     1   30  29    14     1    293   66      1   30   29
## 2   315  950     7   24  38    39    14   3449  835     69  321  414
## 3   479  130    18   66  72    76     3   1624  457     63  224  266
## 4   496  141    20   65  78    37    11   5628 1575    225  828  838
## 5   321   87    10   39  42    30     2    396  101     12   48   46
## 6   594  169     4   74  51    35    11   4408 1133     19  501  336
##   CWalks League Division PutOuts Assists Errors Salary NewLeague
## 1     14      A        E     446      33     20     NA         A
## 2    375      N        W     632      43     10  475.0         N
## 3    263      A        W     880      82     14  480.0         A
## 4    354      N        E     200      11      3  500.0         N
## 5     33      N        E     805      40      4   91.5         N
## 6    194      A        W     282     421     25  750.0         A
```

```
dim(ds)
```

```
## [1] 322  20
```

```
names(ds)
```

```
##  [1] "AtBat"     "Hits"      "HmRun"     "Runs"      "RBI"
##  [6] "Walks"     "Years"     "CatBat"    "CHit"      "CHmRun"
## [11] "CRun"      "CRBI"      "CWalks"    "League"    "Division"
## [16] "PutOuts"   "Assists"   "Errors"    "Salary"    "NewLeague"
```

```
summary(ds)
```

```
##      AtBat             Hits           HmRun            Runs
##  Min.   : 16.0   Min.   :  1.0   Min.   : 0.00   Min.   :  0.00
##  1st Qu.:255.2   1st Qu.: 64.0   1st Qu.: 4.00   1st Qu.: 30.25
##  Median :379.5   Median : 96.0   Median : 8.00   Median : 48.00
##  Mean   :380.9   Mean   :103.7   Mean   :10.77   Mean   : 50.91
##  3rd Qu.:512.0   3rd Qu.:137.8   3rd Qu.:16.00   3rd Qu.: 69.00
##  Max.   :687.0   Max.   :950.0   Max.   :40.00   Max.   :130.00
##
##       RBI             Walks            Years            CatBat
##  Min.   :  0.00   Min.   :  0.00   Min.   : 1.000   Min.   :   19.0
##  1st Qu.: 28.00   1st Qu.: 22.00   1st Qu.: 4.000   1st Qu.:  816.8
##  Median : 44.00   Median : 35.00   Median : 6.000   Median : 1928.0
##  Mean   : 48.03   Mean   : 38.74   Mean   : 7.444   Mean   : 2648.7
##  3rd Qu.: 64.75   3rd Qu.: 53.00   3rd Qu.:11.000   3rd Qu.: 3924.2
##  Max.   :121.00   Max.   :105.00   Max.   :24.000   Max.   :14053.0
##
##       CHit            CHmRun           CRun             CRBI
##  Min.   :   4.0   Min.   :  0.00   Min.   :   1.0   Min.   :   0.00
##  1st Qu.: 209.0   1st Qu.: 14.00   1st Qu.: 100.2   1st Qu.:  88.75
##  Median : 508.0   Median : 37.50   Median : 247.0   Median : 220.50
##  Mean   : 717.6   Mean   : 69.49   Mean   : 358.8   Mean   : 330.12
##  3rd Qu.:1059.2   3rd Qu.: 90.00   3rd Qu.: 526.2   3rd Qu.: 426.25
##  Max.   :4256.0   Max.   :548.00   Max.   :2165.0   Max.   :1659.00
##
```

```
##      CWalks        League  Division    PutOuts          Assists
##  Min.   :   0.00   A:175   E:157    Min.   :   0.0   Min.   :  0.0
##  1st Qu.:  67.25   N:147   W:165    1st Qu.: 109.2   1st Qu.:  7.0
##  Median : 170.50                    Median : 212.0   Median : 39.5
##  Mean   : 260.24                    Mean   : 288.9   Mean   :106.9
##  3rd Qu.: 339.25                    3rd Qu.: 325.0   3rd Qu.:166.0
##  Max.   :1566.00                    Max.   :1378.0   Max.   :492.0
##
##      Errors           Salary       NewLeague
##  Min.   : 0.00   Min.   :  67.5   A:176
##  1st Qu.: 3.00   1st Qu.: 190.0   N:146
##  Median : 6.00   Median : 425.0
##  Mean   : 8.04   Mean   : 535.9
##  3rd Qu.:11.00   3rd Qu.: 750.0
##  Max.   :32.00   Max.   :2460.0
##                  NA's   :59
```

```
ds=na.omit(ds) # removing the NA's of the Salary
dim(ds)
```

```
## [1] 263  20
```

```
model1=lm(Salary~., data=ds)
summary(model1)
```

```
##
## Call:
## lm(formula = Salary ~ ., data = ds)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -869.56 -193.32  -22.83  134.60 1873.28
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  145.22575   92.75984   1.566 0.118741
## AtBat         -0.64967    0.46111  -1.409 0.160141
## Hits           0.39145    0.37498   1.044 0.297562
## HmRun         -1.83802    5.96208  -0.308 0.758129
## Runs           2.94786    2.46373   1.197 0.232666
## RBI            1.22712    2.53702   0.484 0.629046
## Walks          4.47276    1.76643   2.532 0.011970 *
## Years         -1.80218   12.71370  -0.142 0.887394
## CatBat        -0.34012    0.12566  -2.707 0.007278 **
## CHit           1.15335    0.59559   1.936 0.053970 .
## CHmRun         0.89954    1.60684   0.560 0.576116
## CRun           0.61973    0.70857   0.875 0.382649
## CRBI           0.37370    0.68990   0.542 0.588539
## CWalks        -0.55144    0.32187  -1.713 0.087947 .
## LeagueN       78.50054   80.50542   0.975 0.330482
## DivisionW   -122.89677   41.10013  -2.990 0.003075 **
## PutOuts        0.27614    0.07902   3.495 0.000564 ***
## Assists        0.45110    0.22449   2.009 0.045592 *
```

```
## Errors        -5.56545    4.42373  -1.258 0.209567
## NewLeagueN   -43.21387   80.21913  -0.539 0.590589
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 321.3 on 243 degrees of freedom
## Multiple R-squared:  0.5296, Adjusted R-squared:  0.4929
## F-statistic:  14.4 on 19 and 243 DF,  p-value: < 2.2e-16
```

```
AIC(model1)
```

```
## [1] 3803.763
```

```
BIC(model1)
```

```
## [1] 3878.779
```

Let us choose the 7 variables

```
reg_all=regsubsets(Salary~., data=ds, nvmax=7)
```

```
summary(reg_all)
```

```
## Subset selection object
## Call: regsubsets.formula(Salary ~ ., data = ds, nvmax = 7)
## 19 Variables  (and intercept)
##            Forced in Forced out
## AtBat          FALSE      FALSE
## Hits           FALSE      FALSE
## HmRun          FALSE      FALSE
## Runs           FALSE      FALSE
## RBI            FALSE      FALSE
## Walks          FALSE      FALSE
## Years          FALSE      FALSE
## CatBat         FALSE      FALSE
## CHit           FALSE      FALSE
## CHmRun         FALSE      FALSE
## CRun           FALSE      FALSE
## CRBI           FALSE      FALSE
## CWalks         FALSE      FALSE
## LeagueN        FALSE      FALSE
## DivisionW      FALSE      FALSE
## PutOuts        FALSE      FALSE
## Assists        FALSE      FALSE
## Errors         FALSE      FALSE
## NewLeagueN     FALSE      FALSE
## 1 subsets of each size up to 7
## Selection Algorithm: exhaustive
##          AtBat Hits HmRun Runs RBI Walks Years CatBat CHit CHmRun CRun
## 1  ( 1 ) " "   " "  " "   " "  " " " "   " "   " "    " "  " "    " "
```

```
## 2  ( 1 ) " "   " "  " "   "*"  " " " " "   " "   " "    " "  " "    " "
## 3  ( 1 ) " "   " "  " "   "*"  " " " " "   " "   " "    " "  " "    " "
## 4  ( 1 ) " "   " "  " "   "*"  " " " " "   " "   " "    " "  " "    " "
## 5  ( 1 ) " "   " "  " "   " "  " " " " "*"   " "   "*"    "*"  " "    " "
## 6  ( 1 ) " "   " "  " "   " "  " " " " "*"   " "   "*"    "*"  "*"    " "
## 7  ( 1 ) " "   " "  " "   " "  " " " " "*"   " "   "*"    "*"  "*"    " "
##          CRBI CWalks LeagueN DivisionW PutOuts Assists Errors NewLeagueN
## 1  ( 1 ) "*"  " "    " "     " "       " "     " "     " "    " "
## 2  ( 1 ) "*"  " "    " "     " "       " "     " "     " "    " "
## 3  ( 1 ) "*"  " "    " "     " "       "*"     " "     " "    " "
## 4  ( 1 ) "*"  " "    " "     "*"       "*"     " "     " "    " "
## 5  ( 1 ) " "  " "    " "     "*"       "*"     " "     " "    " "
## 6  ( 1 ) " "  " "    " "     "*"       "*"     " "     " "    " "
## 7  ( 1 ) " "  "*"    " "     "*"       "*"     " "     " "    " "
```

```
coef(reg_all, 7)
```

```
##  (Intercept)        Walks       CatBat         CHit       CHmRun
##  119.5168836    5.6070682   -0.3563967    1.5622172    1.5675278
##       CWalks    DivisionW      PutOuts
##   -0.4027386 -138.4992434    0.2464922
```

functions available in regsubset and summary

```
names(reg_all)
```

```
##  [1] "np"        "nrbar"     "d"         "rbar"      "thetab"
##  [6] "first"     "last"      "vorder"    "tol"       "rss"
## [11] "bound"     "nvmax"     "ress"      "ir"        "nbest"
## [16] "lopt"      "il"        "ier"       "xnames"    "method"
## [21] "force.in"  "force.out" "sserr"     "intercept" "lindep"
## [26] "nullrss"   "nn"        "call"
```

```
reg_all_summary = summary(reg_all)
```

```
names(reg_all_summary)
```

```
## [1] "which"  "rsq"    "rss"    "adjr2"  "cp"     "bic"    "outmat" "obj"
```

Forward Selection with nvmax number of regressors

```
forward_reg = regsubsets(Salary~., data=ds, nvmax= 19,method="forward")
summary(forward_reg)
```

```
## Subset selection object
## Call: regsubsets.formula(Salary ~ ., data = ds, nvmax = 19, method = "forward")
## 19 Variables  (and intercept)
```

```
##             Forced in Forced out
## AtBat           FALSE      FALSE
## Hits            FALSE      FALSE
## HmRun           FALSE      FALSE
## Runs            FALSE      FALSE
## RBI             FALSE      FALSE
## Walks           FALSE      FALSE
## Years           FALSE      FALSE
## CatBat          FALSE      FALSE
## CHit            FALSE      FALSE
## CHmRun          FALSE      FALSE
## CRun            FALSE      FALSE
## CRBI            FALSE      FALSE
## CWalks          FALSE      FALSE
## LeagueN         FALSE      FALSE
## DivisionW       FALSE      FALSE
## PutOuts         FALSE      FALSE
## Assists         FALSE      FALSE
## Errors          FALSE      FALSE
## NewLeagueN      FALSE      FALSE
## 1 subsets of each size up to 19
## Selection Algorithm: forward
##           AtBat Hits HmRun Runs RBI Walks Years CatBat CHit CHmRun CRun
## 1  ( 1 )  " "   " "  " "   " "  " " " " " "   " "    " "  " "    " "  " "
## 2  ( 1 )  " "   " "  " "   "*"  " " " " " "   " "    " "  " "    " "  " "
## 3  ( 1 )  " "   " "  " "   "*"  " " " " " "   " "    " "  " "    " "  " "
## 4  ( 1 )  " "   " "  " "   "*"  " " " " " "   " "    " "  " "    " "  " "
## 5  ( 1 )  " "   " "  " "   "*"  " " " " "*"   " "    " "  " "    " "  " "
## 6  ( 1 )  " "   " "  " "   "*"  " " " " "*"   " "    " "  " "    " "  " "
## 7  ( 1 )  " "   " "  " "   "*"  " " " " "*"   " "    " "  " "    " "  "*"
## 8  ( 1 )  " "   " "  " "   "*"  " " " " "*"   " "    "*"  " "    " "  "*"
## 9  ( 1 )  " "   " "  " "   "*"  " " " " "*"   " "    "*"  "*"    " "  "*"
## 10  ( 1 ) " "   " "  " "   "*"  " " " " "*"   " "    "*"  "*"    " "  "*"
## 11  ( 1 ) "*"   " "  " "   "*"  " " " " "*"   " "    "*"  "*"    " "  "*"
## 12  ( 1 ) "*"   " "  " "   "*"  " " " " "*"   " "    "*"  "*"    " "  "*"
## 13  ( 1 ) "*"   "*"  " "   "*"  " " " " "*"   " "    "*"  "*"    " "  "*"
## 14  ( 1 ) "*"   "*"  " "   "*"  " " " " "*"   " "    "*"  "*"    " "  "*"
## 15  ( 1 ) "*"   "*"  " "   "*"  " " " " "*"   " "    "*"  "*"    " "  "*"
## 16  ( 1 ) "*"   "*"  " "   "*"  " " " " "*"   " "    "*"  "*"    "*"  "*"
## 17  ( 1 ) "*"   "*"  " "   "*"  "*" "*" "*"   " "    "*"  "*"    "*"  "*"
## 18  ( 1 ) "*"   "*"  "*"   "*"  "*" "*" "*"   " "    "*"  "*"    "*"  "*"
## 19  ( 1 ) "*"   "*"  "*"   "*"  "*" "*" "*"   "*"    "*"  "*"    "*"  "*"
##           CRBI CWalks LeagueN DivisionW PutOuts Assists Errors NewLeagueN
## 1  ( 1 )  "*"  " "    " "     " "       " "     " "     " "    " "
## 2  ( 1 )  "*"  " "    " "     " "       " "     " "     " "    " "
## 3  ( 1 )  "*"  " "    " "     " "       "*"     " "     " "    " "
## 4  ( 1 )  "*"  " "    " "     "*"       "*"     " "     " "    " "
## 5  ( 1 )  "*"  " "    " "     "*"       "*"     " "     " "    " "
## 6  ( 1 )  "*"  "*"    " "     "*"       "*"     " "     " "    " "
## 7  ( 1 )  "*"  "*"    " "     "*"       "*"     " "     " "    " "
## 8  ( 1 )  "*"  "*"    " "     "*"       "*"     " "     " "    " "
## 9  ( 1 )  "*"  "*"    " "     "*"       "*"     " "     " "    " "
## 10  ( 1 ) "*"  "*"    " "     "*"       "*"     "*"     " "    " "
## 11  ( 1 ) "*"  "*"    " "     "*"       "*"     "*"     " "    " "
```

```
## 12  ( 1 ) "*"  "*"    " "     "*"       "*"     "*"     "*"    " "
## 13  ( 1 ) "*"  "*"    " "     "*"       "*"     "*"     "*"    " "
## 14  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    " "
## 15  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 16  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 17  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 18  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 19  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
```

```
names(forward_reg)
```

```
##  [1] "np"        "nrbar"     "d"         "rbar"      "thetab"
##  [6] "first"     "last"      "vorder"    "tol"       "rss"
## [11] "bound"     "nvmax"     "ress"      "ir"        "nbest"
## [16] "lopt"      "il"        "ier"       "xnames"    "method"
## [21] "force.in"  "force.out" "sserr"     "intercept" "lindep"
## [26] "nullrss"   "nn"        "call"
```

Backward Elimination with nvmax number of regressors

```
backward_reg = regsubsets(Salary~., data=ds, nvmax= 19, method="backward")
summary(backward_reg)
```

```
## Subset selection object
## Call: regsubsets.formula(Salary ~ ., data = ds, nvmax = 19, method = "backward")
## 19 Variables  (and intercept)
##            Forced in Forced out
## AtBat          FALSE      FALSE
## Hits           FALSE      FALSE
## HmRun          FALSE      FALSE
## Runs           FALSE      FALSE
## RBI            FALSE      FALSE
## Walks          FALSE      FALSE
## Years          FALSE      FALSE
## CatBat         FALSE      FALSE
## CHit           FALSE      FALSE
## CHmRun         FALSE      FALSE
## CRun           FALSE      FALSE
## CRBI           FALSE      FALSE
## CWalks         FALSE      FALSE
## LeagueN        FALSE      FALSE
## DivisionW      FALSE      FALSE
## PutOuts        FALSE      FALSE
## Assists        FALSE      FALSE
## Errors         FALSE      FALSE
## NewLeagueN     FALSE      FALSE
## 1 subsets of each size up to 19
## Selection Algorithm: backward
##           AtBat Hits HmRun Runs RBI Walks Years CatBat CHit CHmRun CRun
## 1  ( 1 )  " "   " "  " "   " "  " " " " " "   " "    " "    "*"   " "    " "
## 2  ( 1 )  " "   " "  " "   " "  " " " " "*"   " "    " "    "*"   " "    " "
```

```
## 3  ( 1 )  " "   " "  " "   " "  " " "*"   " "   "*"    "*"  " "    " "
## 4  ( 1 )  " "   " "  " "   " "  " " "*"   " "   "*"    "*"  " "    " "
## 5  ( 1 )  " "   " "  " "   " "  " " "*"   " "   "*"    "*"  " "    " "
## 6  ( 1 )  " "   " "  " "   " "  " " "*"   " "   "*"    "*"  " "    " "
## 7  ( 1 )  " "   " "  " "   " "  " " "*"   " "   "*"    "*"  " "    " "
## 8  ( 1 )  " "   " "  " "   " "  " " "*"   " "   "*"    "*"  " "    "*"
## 9  ( 1 )  " "   " "  " "   " "  " " "*"   " "   "*"    "*"  " "    "*"
## 10  ( 1 ) " "   " "  " "   "*"  " " "*"   " "   "*"    "*"  " "    "*"
## 11  ( 1 ) "*"   " "  " "   "*"  " " "*"   " "   "*"    "*"  " "    "*"
## 12  ( 1 ) "*"   " "  " "   "*"  " " "*"   " "   "*"    "*"  " "    "*"
## 13  ( 1 ) "*"   "*"  " "   "*"  " " "*"   " "   "*"    "*"  " "    "*"
## 14  ( 1 ) "*"   "*"  " "   "*"  " " "*"   " "   "*"    "*"  " "    "*"
## 15  ( 1 ) "*"   "*"  " "   "*"  " " "*"   " "   "*"    "*"  " "    "*"
## 16  ( 1 ) "*"   "*"  " "   "*"  " " "*"   " "   "*"    "*"  "*"    "*"
## 17  ( 1 ) "*"   "*"  " "   "*"  "*" "*"   " "   "*"    "*"  "*"    "*"
## 18  ( 1 ) "*"   "*"  "*"   "*"  "*" "*"   " "   "*"    "*"  "*"    "*"
## 19  ( 1 ) "*"   "*"  "*"   "*"  "*" "*"   "*"   "*"    "*"  "*"    "*"
##           CRBI CWalks LeagueN DivisionW PutOuts Assists Errors NewLeagueN
## 1  ( 1 )  " "  " "    " "     " "       " "     " "     " "    " "
## 2  ( 1 )  " "  " "    " "     " "       " "     " "     " "    " "
## 3  ( 1 )  " "  " "    " "     " "       " "     " "     " "    " "
## 4  ( 1 )  " "  " "    " "     " "       "*"     " "     " "    " "
## 5  ( 1 )  " "  " "    " "     "*"       "*"     " "     " "    " "
## 6  ( 1 )  "*"  " "    " "     "*"       "*"     " "     " "    " "
## 7  ( 1 )  "*"  "*"    " "     "*"       "*"     " "     " "    " "
## 8  ( 1 )  "*"  "*"    " "     "*"       "*"     " "     " "    " "
## 9  ( 1 )  "*"  "*"    " "     "*"       "*"     "*"     " "    " "
## 10  ( 1 ) "*"  "*"    " "     "*"       "*"     "*"     " "    " "
## 11  ( 1 ) "*"  "*"    " "     "*"       "*"     "*"     " "    " "
## 12  ( 1 ) "*"  "*"    " "     "*"       "*"     "*"     "*"    " "
## 13  ( 1 ) "*"  "*"    " "     "*"       "*"     "*"     "*"    " "
## 14  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    " "
## 15  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 16  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 17  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 18  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 19  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
```

```
names(backward_reg)
```

```
##  [1] "np"        "nrbar"     "d"         "rbar"      "thetab"
##  [6] "first"     "last"      "vorder"    "tol"       "rss"
## [11] "bound"     "nvmax"     "ress"      "ir"        "nbest"
## [16] "lopt"      "il"        "ier"       "xnames"    "method"
## [21] "force.in"  "force.out" "sserr"     "intercept" "lindep"
## [26] "nullrss"   "nn"        "call"
```

Variable Selection using nvmax=5

```
reg_all_5 = regsubsets(Salary~., data=ds, nvmax=5)
#reg_all_5
```

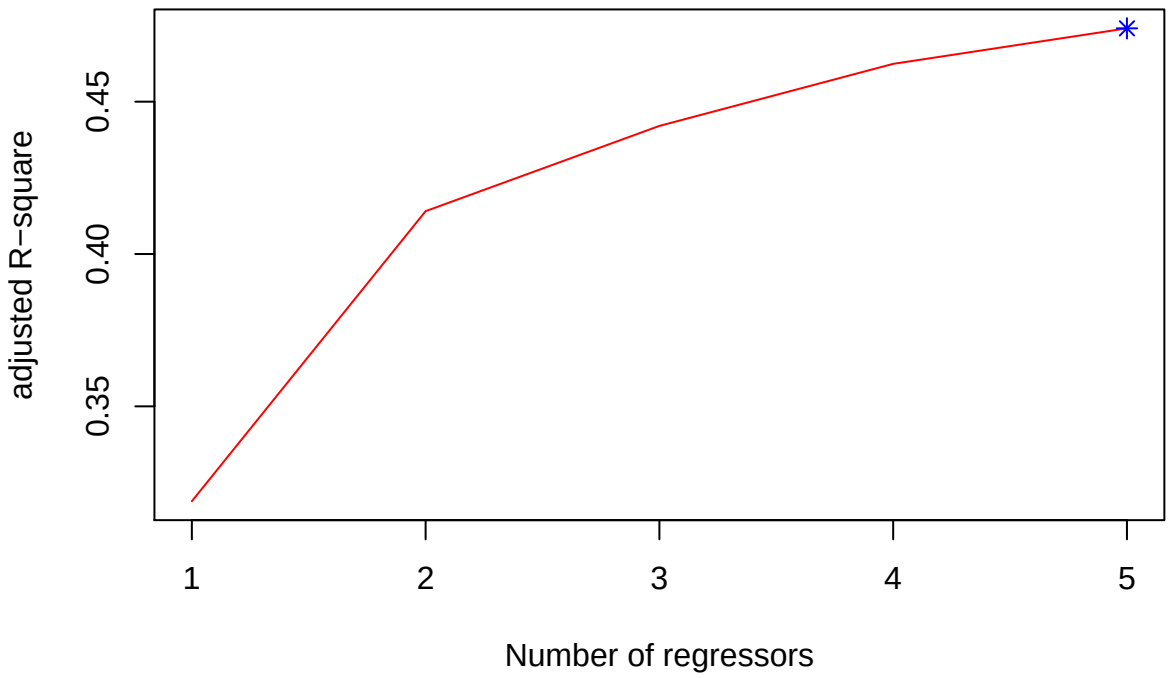
```r
summary_5 = summary(reg_all_5)
summary_5
```

```
## Subset selection object
## Call: regsubsets.formula(Salary ~ ., data = ds, nvmax = 5)
## 19 Variables  (and intercept)
##            Forced in Forced out
## AtBat          FALSE      FALSE
## Hits           FALSE      FALSE
## HmRun          FALSE      FALSE
## Runs           FALSE      FALSE
## RBI            FALSE      FALSE
## Walks          FALSE      FALSE
## Years          FALSE      FALSE
## CatBat         FALSE      FALSE
## CHit           FALSE      FALSE
## CHmRun         FALSE      FALSE
## CRun           FALSE      FALSE
## CRBI           FALSE      FALSE
## CWalks         FALSE      FALSE
## LeagueN        FALSE      FALSE
## DivisionW      FALSE      FALSE
## PutOuts        FALSE      FALSE
## Assists        FALSE      FALSE
## Errors         FALSE      FALSE
## NewLeagueN     FALSE      FALSE
## 1 subsets of each size up to 5
## Selection Algorithm: exhaustive
##          AtBat Hits HmRun Runs RBI Walks Years CatBat CHit CHmRun CRun
## 1  ( 1 ) " "   " "  " "   " "  " " " "   " "   " "    " "  " "    " "
## 2  ( 1 ) " "   " "  " "   "*"  " " " "   " "   " "    " "  " "    " "
## 3  ( 1 ) " "   " "  " "   "*"  " " " "   " "   " "    " "  " "    " "
## 4  ( 1 ) " "   " "  " "   "*"  " " " "   " "   " "    " "  " "    " "
## 5  ( 1 ) " "   " "  " "   " "  " " "*"   " "   "*"    "*"  " "    " "
##          CRBI CWalks LeagueN DivisionW PutOuts Assists Errors NewLeagueN
## 1  ( 1 ) "*"  " "    " "     " "       " "     " "     " "    " "
## 2  ( 1 ) "*"  " "    " "     " "       " "     " "     " "    " "
## 3  ( 1 ) "*"  " "    " "     " "       "*"     " "     " "    " "
## 4  ( 1 ) "*"  " "    " "     "*"       "*"     " "     " "    " "
## 5  ( 1 ) " "  " "    " "     "*"       "*"     " "     " "    " "
```

```r
bestsubset_5=which.max(summary_5$adjr2)
bestsubset_5
```

```
## [1] 5
```

```r
plot(summary_5$adjr2, xlab="Number of regressors", ylab="adjusted R-square", type ="l", col="red")
points(bestsubset_5,summary_5$adjr2[bestsubset_5],col="blue",pch = 8)
```



From the above curve we can notice that, it is not yet reached the optimum number of regressors

Variable Selection using nvmax=19

```
reg_all_19=regsubsets(Salary~., data=ds, nvmax=19)
```

```
summary(reg_all_19)
```

```
## Subset selection object
## Call: regsubsets.formula(Salary ~ ., data = ds, nvmax = 19)
## 19 Variables  (and intercept)
##           Forced in Forced out
## AtBat         FALSE      FALSE
## Hits          FALSE      FALSE
## HmRun         FALSE      FALSE
## Runs          FALSE      FALSE
## RBI           FALSE      FALSE
## Walks         FALSE      FALSE
## Years         FALSE      FALSE
## CatBat        FALSE      FALSE
## CHit          FALSE      FALSE
## CHmRun        FALSE      FALSE
## CRun          FALSE      FALSE
## CRBI          FALSE      FALSE
```

```
## CWalks          FALSE      FALSE
## LeagueN         FALSE      FALSE
## DivisionW       FALSE      FALSE
## PutOuts         FALSE      FALSE
## Assists         FALSE      FALSE
## Errors          FALSE      FALSE
## NewLeagueN      FALSE      FALSE
## 1 subsets of each size up to 19
## Selection Algorithm: exhaustive
##           AtBat Hits HmRun Runs RBI Walks Years CatBat CHit CHmRun CRun
## 1  ( 1 )  " "   " "  " "   " "  " " " " " "   " "    " "  " "    " "  " "
## 2  ( 1 )  " "   " "  " "   "*"  " " " " " "   " "    " "  " "    " "  " "
## 3  ( 1 )  " "   " "  " "   "*"  " " " " " "   " "    " "  " "    " "  " "
## 4  ( 1 )  " "   " "  " "   "*"  " " " " " "   " "    " "  " "    " "  " "
## 5  ( 1 )  " "   " "  " "   " "  " " " " "*"   " "    "*"  "*"    " "  " "
## 6  ( 1 )  " "   " "  " "   " "  " " " " "*"   " "    "*"  "*"    "*"  " "
## 7  ( 1 )  " "   " "  " "   " "  " " " " "*"   " "    "*"  "*"    "*"  " "
## 8  ( 1 )  " "   " "  " "   " "  " " " " "*"   " "    "*"  "*"    "*"  " "
## 9  ( 1 )  " "   " "  " "   " "  " " " " "*"   " "    "*"  "*"    " "  "*"
## 10  ( 1 ) " "   " "  " "   " "  " " " " "*"   " "    "*"  "*"    " "  "*"
## 11  ( 1 ) "*"   " "  " "   "*"  " " " " "*"   " "    "*"  "*"    "*"  " "
## 12  ( 1 ) "*"   "*"  " "   "*"  " " " " "*"   " "    "*"  "*"    "*"  " "
## 13  ( 1 ) "*"   "*"  " "   "*"  " " " " "*"   " "    "*"  "*"    "*"  " "
## 14  ( 1 ) "*"   "*"  " "   "*"  " " " " "*"   " "    "*"  "*"    " "  "*"
## 15  ( 1 ) "*"   "*"  " "   "*"  " " " " "*"   " "    "*"  "*"    " "  "*"
## 16  ( 1 ) "*"   "*"  " "   "*"  " " " " "*"   " "    "*"  "*"    "*"  "*"
## 17  ( 1 ) "*"   "*"  " "   "*"  "*" "*" "*"   " "    "*"  "*"    "*"  "*"
## 18  ( 1 ) "*"   "*"  "*"   "*"  "*" "*" "*"   " "    "*"  "*"    "*"  "*"
## 19  ( 1 ) "*"   "*"  "*"   "*"  "*" "*" "*"   "*"    "*"  "*"    "*"  "*"
##           CRBI CWalks LeagueN DivisionW PutOuts Assists Errors NewLeagueN
## 1  ( 1 )  "*"  " "    " "     " "       " "     " "     " "    " "
## 2  ( 1 )  "*"  " "    " "     " "       " "     " "     " "    " "
## 3  ( 1 )  "*"  " "    " "     " "       "*"     " "     " "    " "
## 4  ( 1 )  "*"  " "    " "     "*"       "*"     " "     " "    " "
## 5  ( 1 )  " "  " "    " "     "*"       "*"     " "     " "    " "
## 6  ( 1 )  " "  " "    " "     "*"       "*"     " "     " "    " "
## 7  ( 1 )  " "  "*"    " "     "*"       "*"     " "     " "    " "
## 8  ( 1 )  " "  "*"    " "     "*"       "*"     "*"     " "    " "
## 9  ( 1 )  "*"  "*"    " "     "*"       "*"     "*"     " "    " "
## 10  ( 1 ) "*"  "*"    " "     "*"       "*"     "*"     "*"    " "
## 11  ( 1 ) " "  "*"    " "     "*"       "*"     "*"     "*"    " "
## 12  ( 1 ) " "  "*"    " "     "*"       "*"     "*"     "*"    " "
## 13  ( 1 ) " "  "*"    "*"     "*"       "*"     "*"     "*"    " "
## 14  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    " "
## 15  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 16  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 17  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 18  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
## 19  ( 1 ) "*"  "*"    "*"     "*"       "*"     "*"     "*"    "*"
```

```
summary_19 = summary(reg_all_19)
summary_19$adjr2
```

```
##  [1] 0.3188503 0.4140632 0.4420427 0.4624180 0.4740707 0.4933275 0.4981264
```

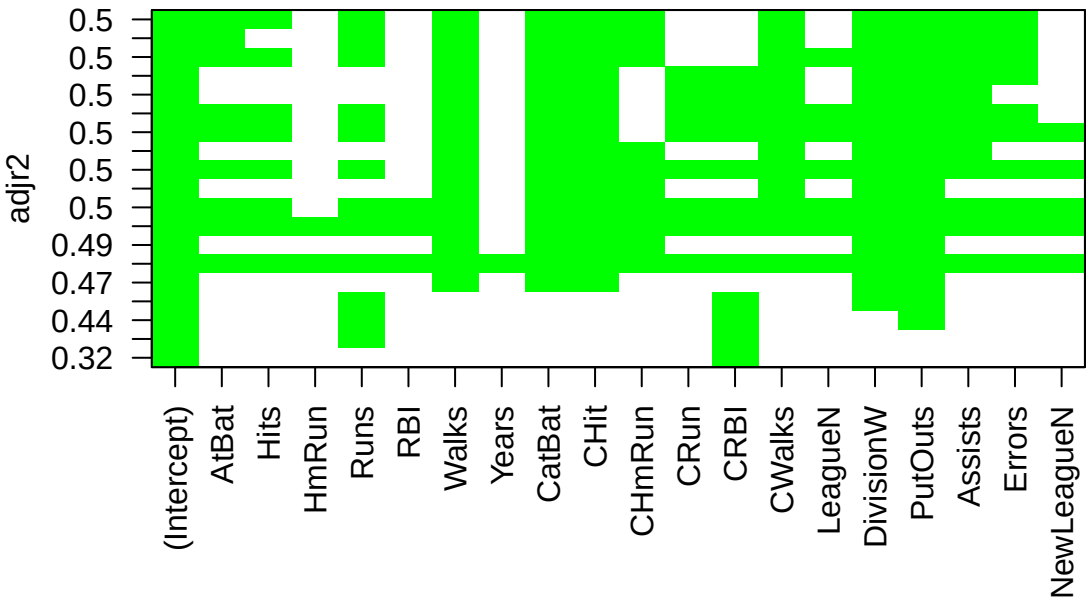
```
##  [8] 0.4999857 0.5015259 0.5019771 0.5020751 0.5021206 0.5019859 0.5014591
## [15] 0.4999994 0.4985190 0.4967643 0.4948937 0.4928570
```

```
bestsubset_19=which.max(summary_19$adjr2)
bestsubset_19
```

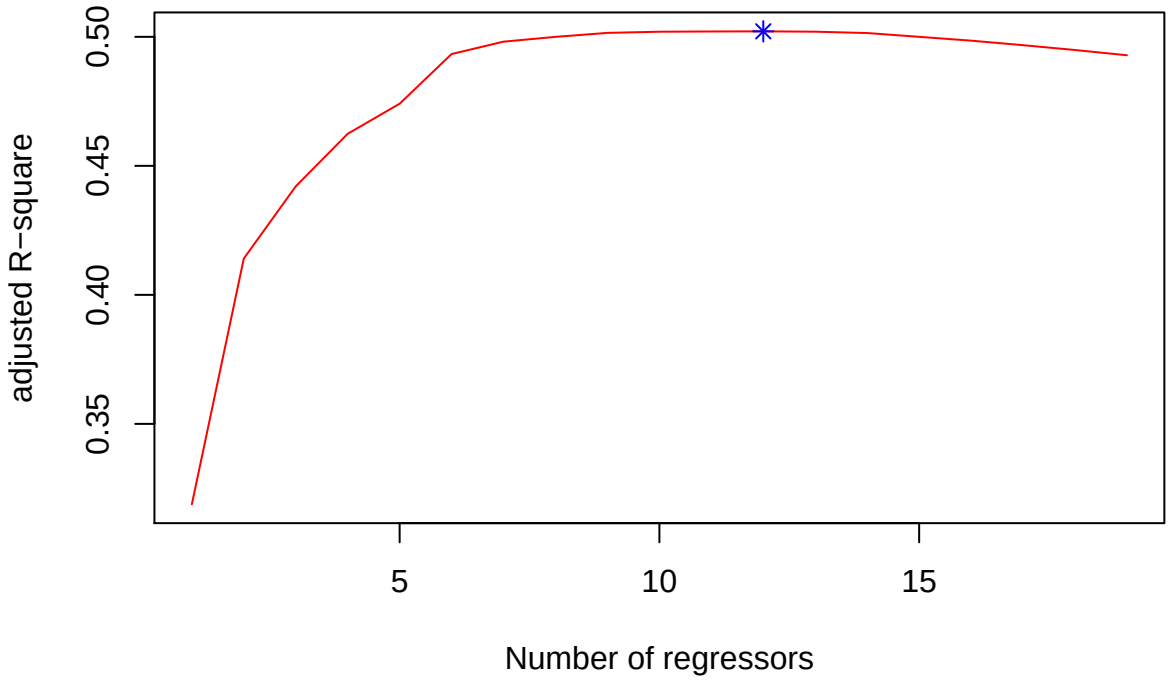
```
## [1] 12
```

Plots for variable selection

```
plot(reg_all_19, scale="adjr2", col="green")
```




```
plot(summary_19$adjr2, xlab="Number of regressors", ylab="adjusted R-square", type ="l", col="red")
points(bestsubset_19,summary_19$adjr2[bestsubset_19],col="blue",pch = 8)
```


adjusted R−square
0.35
0.40
0.45
0.50
5
10
15
Number of regressors