Project 1

MA8701

Group 5 : Yellow Submarine

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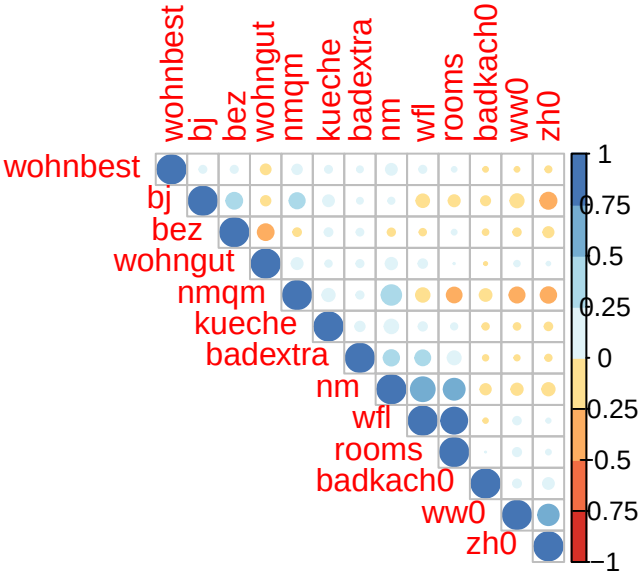
The Data Set

For our project work we use the Munich Rent 2003 data set as described in https://rdrr.io/cran/LinRegInteractive/man/munichrent03.html.

The data set has the covariates - `nmqm`: rent per square meter (numeric) - `wfl`: area in square meters (numeric) - `rooms`: number of rooms (numeric) - `bj`: year of construction (factor) - `bez`: district (factor) - `wohngut`: quality of location (factor) - `wohnbest`: high quality of location (factor) - `ww0`: hot water supply available (factor) - `zh0`: central heating (factor) - `badkach0`: tiled bathroom (factor) - `badextra`: high-quality bathroom (factor) - `kueche`: upscale kitchen equipment (factor) and the response - `nm`: rental price (numeric).




```
## 'data.frame':    2053 obs. of  13 variables:
##  $ nm       : num  741 716 528 554 698 ...
##  $ nmqm     : num  10.9 11.01 8.38 8.52 6.98 ...
##  $ wfl      : int  68 65 63 65 100 81 55 79 52 77 ...
##  $ rooms    : int  2 2 3 3 4 4 2 3 1 3 ...
##  $ bj       : Factor w/ 44 levels "1918","1924",..: 1 37 1 25 37 22 2 2 5 4 ...
##  $ bez      : Factor w/ 25 levels "1","2","3","4",..: 2 2 2 16 16 16 6 6 6 6 ...
##  $ wohngut  : int  1 1 1 0 1 0 0 0 0 0 ...
##  $ wohnbest: int  0 0 0 0 0 0 0 0 0 0 ...
##  $ ww0      : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ zh0      : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ badkach0: int  0 0 0 0 0 0 0 0 0 0 ...
```

```
##  $ badextra: int  0 0 0 1 1 0 1 0 0 0 ...
##  $ kueche  : int  0 0 0 0 1 0 0 0 0 0 ...
```

We store the data set in an R data frame for all further computations.

```
# Create model matrix without intercept and nmqm
# (since nmqm*wfl=nm gives the response directly)
x_mod <- model.matrix(nm~.-nmqm,data=munich_house)[,-1]
y_mod <- munich_house$nm
df_mod <- data.frame(y_mod,x_mod)
colnames(df_mod)[1]="nm"
```

Regression

We start with a vanilla regression for reference.

```
##
## Call:
## lm(formula = nm ~ ., data = df_mod)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -616.33  -78.78   -1.42   82.19  705.60
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  162.3104    27.8995   5.818 6.94e-09 ***
## wfl            6.9216     0.2635  26.263  < 2e-16 ***
## rooms        -12.9199     6.4332  -2.008 0.044743 *
## bj1924      -100.1093    19.6709  -5.089 3.94e-07 ***
## bj1939       -51.0820    40.0059  -1.277 0.201801
## bj1948       -43.4699    17.1866  -2.529 0.011507 *
## bj1957       -24.2381    13.1852  -1.838 0.066170 .
## bj1957.5      18.7138    19.6667   0.952 0.341443
## bj1960        19.5617    15.5390   1.259 0.208223
## bj1966         5.9203    13.9939   0.423 0.672292
## bj1967        17.4326    27.0595   0.644 0.519499
## bj1968         6.1619    32.4242   0.190 0.849297
## bj1969       -35.1239    24.9312  -1.409 0.159042
## bj1970         8.1467    24.1903   0.337 0.736322
## bj1971        22.7388    27.0303   0.841 0.400318
## bj1972         3.4642    18.3819   0.188 0.850538
## bj1973        22.2193    22.3580   0.994 0.320445
## bj1974        43.7002    29.1988   1.497 0.134645
## bj1975        12.5650    38.5568   0.326 0.744548
## bj1976       -86.6050    57.0576  -1.518 0.129211
## bj1977        97.6443    60.8334   1.605 0.108629
## bj1978        44.0685    66.2852   0.665 0.506236
## bj1979        50.1127    61.2159   0.819 0.413101
## bj1980        49.9373    36.6220   1.364 0.172852
## bj1981        88.5097    39.0632   2.266 0.023571 *
## bj1982       -17.1652    52.8476  -0.325 0.745363
## bj1983        74.8158    25.1821   2.971 0.003004 **
## bj1984        80.9532    37.2329   2.174 0.029805 *
## bj1985       105.8678    34.4111   3.077 0.002123 **
```

```
## bj1986        59.2255    45.4133   1.304 0.192336
## bj1987        49.1158    34.2715   1.433 0.151977
## bj1988       147.9157    42.3852   3.490 0.000494 ***
## bj1989        77.6490    39.4970   1.966 0.049445 *
## bj1990       154.2909    47.4466   3.252 0.001166 **
## bj1991        71.3473    41.2410   1.730 0.083785 .
## bj1992        86.5411    31.9958   2.705 0.006894 **
## bj1993        90.3129    25.1462   3.592 0.000337 ***
## bj1994       239.5327    41.9447   5.711 1.30e-08 ***
## bj1995        90.1354    49.9745   1.804 0.071442 .
## bj1996       123.4211    34.5818   3.569 0.000367 ***
## bj1997        88.8192    43.9147   2.023 0.043255 *
## bj1998       177.0494    40.6209   4.359 1.38e-05 ***
## bj1998.5     119.0793    28.0125   4.251 2.23e-05 ***
## bj1999        47.0015    57.0361   0.824 0.410002
## bj2000       120.2847    35.8825   3.352 0.000817 ***
## bj2001       218.5516    67.0896   3.258 0.001143 **
## bez2         -35.9851    25.4861  -1.412 0.158122
## bez3         -16.2744    26.2572  -0.620 0.535455
## bez4         -34.4740    26.0011  -1.326 0.185036
## bez5         -38.4664    25.8800  -1.486 0.137350
## bez6         -59.2431    29.6860  -1.996 0.046109 *
## bez7        -101.9950    29.8102  -3.421 0.000636 ***
## bez8         -65.3975    30.1790  -2.167 0.030355 *
## bez9         -52.0535    25.3943  -2.050 0.040515 *
## bez10        -63.8332    30.9749  -2.061 0.039453 *
## bez11        -98.8313    29.9727  -3.297 0.000993 ***
## bez12        -32.0354    28.2229  -1.135 0.256478
## bez13        -41.7103    27.8436  -1.498 0.134287
## bez14       -115.8630    30.5571  -3.792 0.000154 ***
## bez15        -85.0417    33.4341  -2.544 0.011048 *
## bez16       -109.2551    27.5635  -3.964 7.64e-05 ***
## bez17        -76.9986    29.6753  -2.595 0.009537 **
## bez18        -39.0532    28.6017  -1.365 0.172278
## bez19        -67.3556    27.6692  -2.434 0.015008 *
## bez20        -82.5750    31.8512  -2.593 0.009598 **
## bez21        -73.1990    30.3489  -2.412 0.015960 *
## bez22       -102.4685    38.8056  -2.641 0.008342 **
## bez23       -116.8833    46.5163  -2.513 0.012059 *
## bez24       -114.4170    36.5471  -3.131 0.001770 **
## bez25        -83.9379    27.1701  -3.089 0.002034 **
## wohngut       24.9111     8.3923   2.968 0.003030 **
## wohnbest     123.2647    23.5906   5.225 1.92e-07 ***
## ww0         -173.0875    20.8217  -8.313  < 2e-16 ***
## zh0          -82.6242    14.3232  -5.769 9.26e-09 ***
## badkach0     -34.4896     8.6321  -3.996 6.69e-05 ***
## badextra      48.6276    11.9878   4.056 5.18e-05 ***
## kueche       101.8619    13.2662   7.678 2.52e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 146 on 1976 degrees of freedom
## Multiple R-squared:  0.6591, Adjusted R-squared:  0.646
## F-statistic: 50.28 on 76 and 1976 DF,  p-value: < 2.2e-16
```

Remark: Interestingly in the regression, the significance of different `bjs` and `bezs` varies a lot.

Shrinkage

After we saw the results for the linear regression, we continue with shrinkage methods.

Subset selection

```
munich_house <- read.table(
  "https://data.ub.uni-muenchen.de/2/1/miete03.asc",
  sep="\t", header=TRUE)
x <- apply(munich_house[, -c(1, 2)], 2, scale) # standardize input
y <- munich_house[, 1] -  mean(munich_house[, 1]) # centralize output to remove intercept
data <- data.frame(y, x)
bests <- regsubsets(x, y)
sumbests <- summary(bests)
print(sumbests)
```

```
## Subset selection object
## 11 Variables  (and intercept)
##          Forced in Forced out
## wfl          FALSE      FALSE
## rooms        FALSE      FALSE
## bj           FALSE      FALSE
## bez          FALSE      FALSE
## wohngut      FALSE      FALSE
## wohnbest     FALSE      FALSE
## ww0          FALSE      FALSE
## zh0          FALSE      FALSE
## badkach0     FALSE      FALSE
## badextra     FALSE      FALSE
## kueche       FALSE      FALSE
## 1 subsets of each size up to 8
## Selection Algorithm: exhaustive
##          wfl rooms bj  bez wohngut wohnbest ww0 zh0 badkach0 badextra kueche
## 1  ( 1 ) "*" " "   " " " " " "     " "      " " " " " "      " "      " "
## 2  ( 1 ) "*" " "   " " " " " "     " "      "*" " " " "      " "      " "
## 3  ( 1 ) "*" " "   " " " " " "     " "      "*" " " " "      " "      "*"
## 4  ( 1 ) "*" " "   "*" " " " "     " "      "*" " " " "      " "      "*"
## 5  ( 1 ) "*" " "   "*" " " "*"     " "      "*" " " " "      " "      "*"
## 6  ( 1 ) "*" " "   "*" " " "*"     "*"      "*" " " " "      " "      "*"
## 7  ( 1 ) "*" " "   "*" " " "*"     "*"      "*" " " "*"      " "      "*"
## 8  ( 1 ) "*" " "   "*" "*" "*"     "*"      "*" " " "*"      " "      "*"
```

```
which.min(sumbests$cp)
```

```
## [1] 8
```

```
lm_sub <- lm(y ~ wfl + bj + bez + wohngut + ww0 + badkach0 + kueche, data = data)
summary(lm_sub)
```

```
##
## Call:
## lm(formula = y ~ wfl + bj + bez + wohngut + ww0 + badkach0 +
##     kueche, data = data)
```

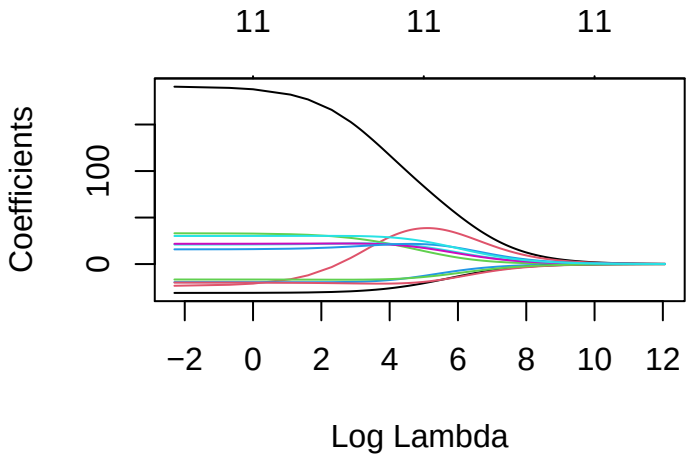
```
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -575.49  -86.87   -1.94   86.86  877.91
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.788e-13  3.393e+00   0.000        1
## wfl          1.782e+02  3.502e+00  50.887  < 2e-16 ***
## bj           3.942e+01  3.764e+00  10.475  < 2e-16 ***
## bez         -1.897e+01  3.743e+00  -5.068 4.39e-07 ***
## wohngut      2.121e+01  3.593e+00   5.904 4.15e-09 ***
## ww0         -4.185e+01  3.485e+00 -12.008  < 2e-16 ***
## badkach0    -1.940e+01  3.425e+00  -5.663 1.70e-08 ***
## kueche       3.293e+01  3.469e+00   9.492  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 153.8 on 2045 degrees of freedom
## Multiple R-squared:  0.6089, Adjusted R-squared:  0.6075
## F-statistic: 454.8 on 7 and 2045 DF,  p-value: < 2.2e-16
```

```
confint(lm_sub)
```

```
##                  2.5 %     97.5 %
## (Intercept)  -6.654962   6.654962
## wfl         171.323527 185.058170
## bj           32.042215  46.804392
## bez         -26.309192 -11.627964
## wohngut      14.164450  28.256379
## ww0         -48.686830 -35.016097
## badkach0    -26.111496 -12.678543
## kueche       26.126114  39.734004
```

Ridge

```
munich_house <- read.table(
  "https://data.ub.uni-muenchen.de/2/1/miete03.asc",
  sep="\t", header=TRUE)
x <- apply(munich_house[, -c(1, 2)], 2, scale) # standardize input
y <- munich_house[, 1] -  mean(munich_house[, 1]) # centralize output to remove intercept
data <- data.frame(y, x)
start <- glmnet(x = x, y = y, alpha = 0)
autolambda <- start$lambda
newlambda <- c(autolambda, 10, 5, 3, 1, 0.5, 0.1) # add more to approach zero lambda
ridge_fit <- glmnet(x, y, alpha = 0, lambda = newlambda)
plot(ridge_fit, xvar = "lambda", label = T)
```



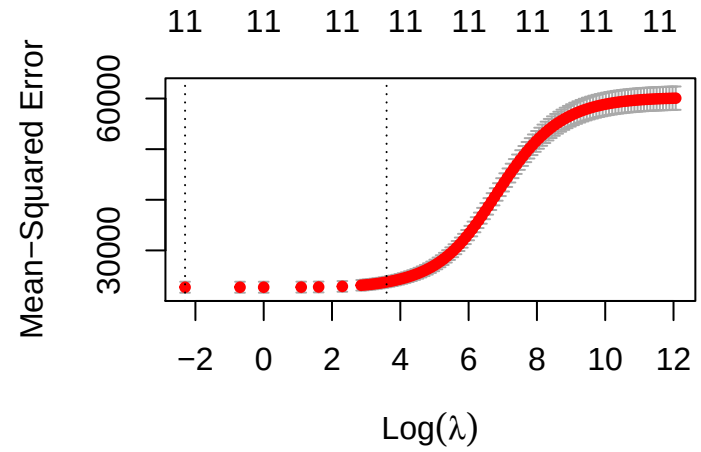

```
cv.ridge <- cv.glmnet(x, y, alpha = 0, lambda = newlambda)
print(paste("The lamda giving the smallest CV error",cv.ridge$lambda.min))
```

```
## [1] "The lamda giving the smallest CV error 0.1"
```

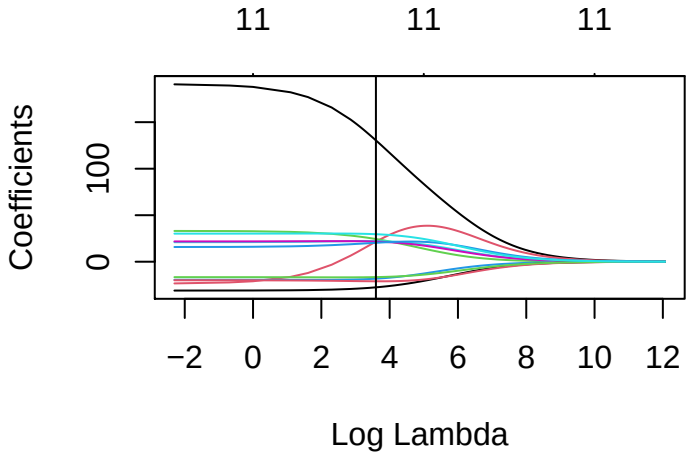
```
print(paste("The 1sd err method lambda",cv.ridge$lambda.1se))
```

```
## [1] "The 1sd err method lambda 36.5397591094134"
```

```
plot(cv.ridge)
```




```
plot(ridge_fit, xvar = "lambda", label = T) + abline(v = log(cv.ridge$lambda.1se))
```

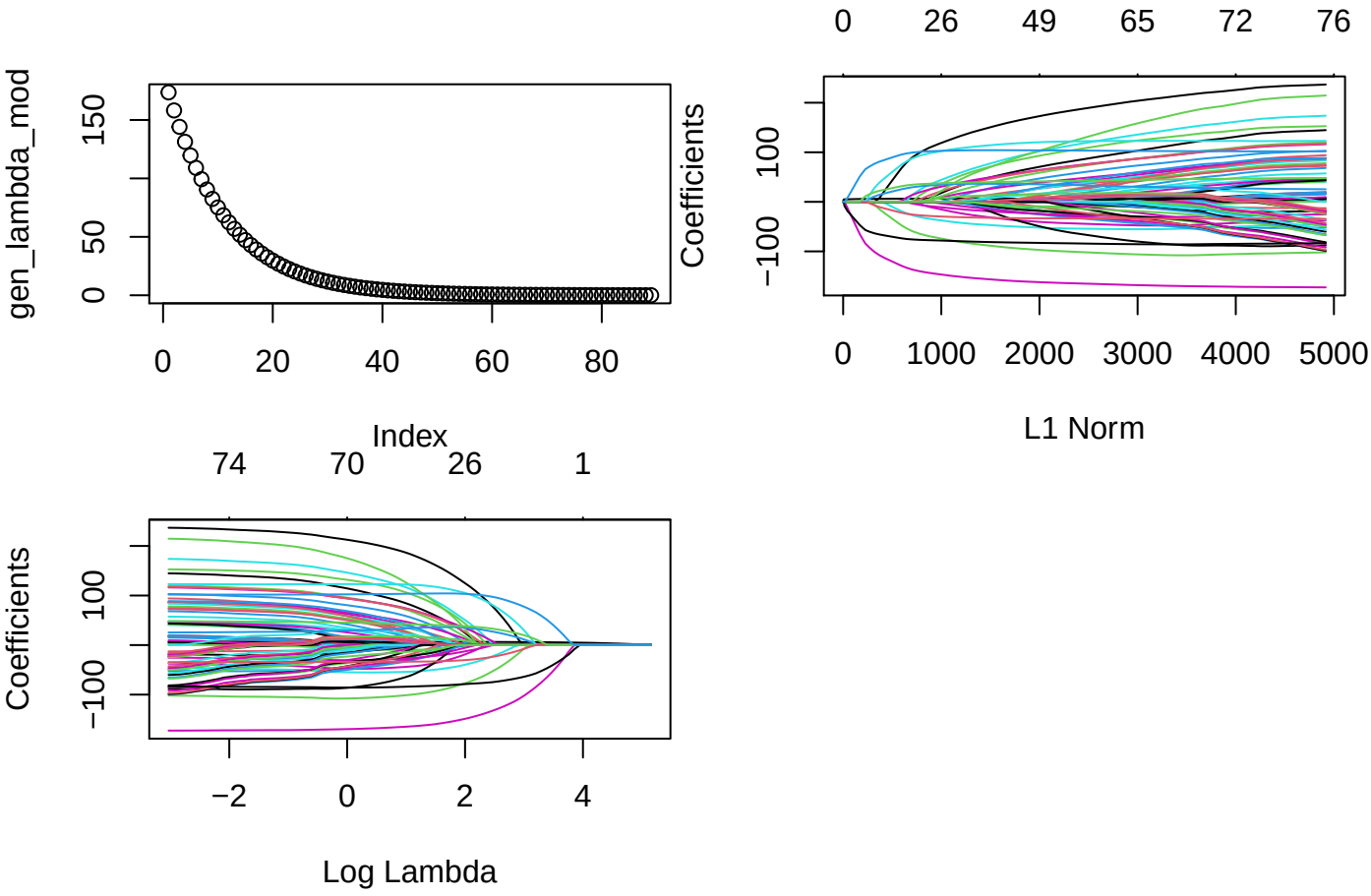


```
## integer(0)
```

```
coef(cv.ridge)
```

```
## 12 x 1 sparse Matrix of class "dgCMatrix"
##                            1
## (Intercept)  9.325703e-14
## wfl           1.304335e+02
## rooms         2.154011e+01
## bj            2.437694e+01
## bez          -1.823033e+01
## wohngut       2.214066e+01
## wohnbest      2.161357e+01
## ww0          -2.754683e+01
## zh0          -2.104858e+01
## badkach0     -1.655311e+01
## badextra      2.034523e+01
## kueche        2.955710e+01
```

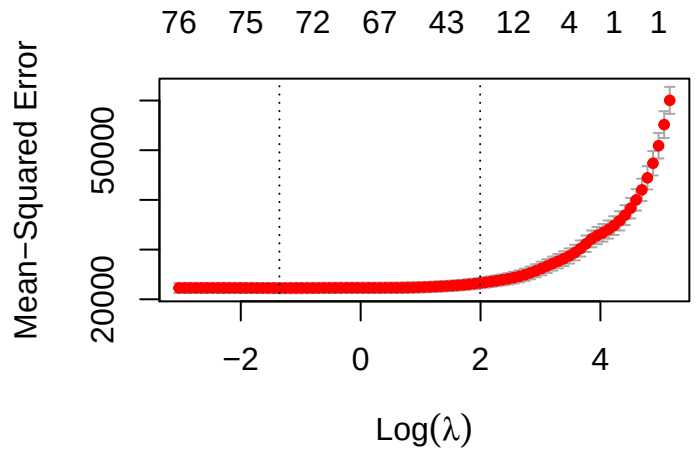
Lasso



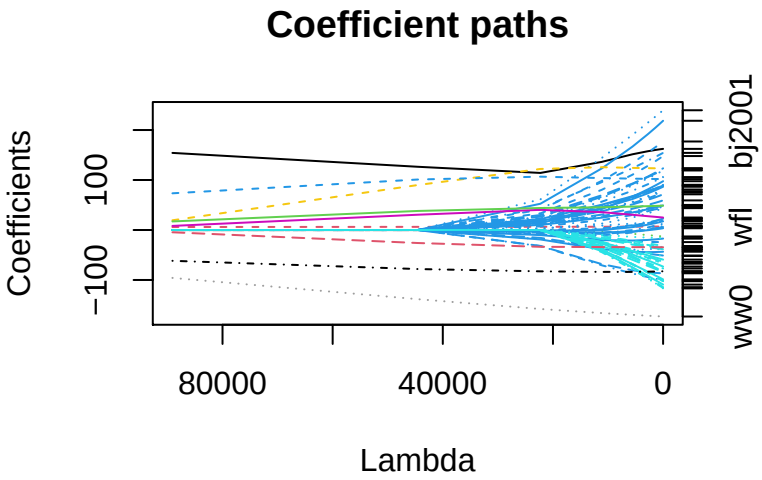
For the λ with one standard deviation, we observe that many of the `bjs` and `bez`s get shrinked, but not all of them - and the values differ from the linear regression. Whereas the other kept covariants roughly keep their parameter.

Above we considered a fixed λ, now we analyse which λ is optimal using cross validation.

```
## [1] "The lamda giving the smallest CV error 0.257780776529151"
## [1] "The 1sd err method lambda 7.34168895458238"
```



Group lasso




```
## List of 18
##  $ x                : NULL
##  $ y                : num [1:2053] 741 716 528 554 698 ...
##  $ coefficients     : num [1:77, 1:18] 154.21 5.96 0 0 0 ...
##   ..- attr(*, "dimnames")=List of 2
##   .. ..$ : chr [1:77] "Intercept" "wfl" "rooms" "bj1924" ...
##   .. ..$ : chr [1:18] "89096.8420767937" "44548.4210383969" "22274.2105191984" "11137.1052595992" ..
##  $ norms.pen        : num [1:11, 1:18] 149.92 0 0 0 3.98 ...
##   ..- attr(*, "dimnames")=List of 2
##   .. ..$ : NULL
##   .. ..$ : chr [1:18] "89096.8420767937" "44548.4210383969" "22274.2105191984" "11137.1052595992" ..
##  $ lambda           : num [1:18] 89097 44548 22274 11137 5569 ...
##  $ index            : num [1:77] NA 1 2 3 3 3 3 3 3 3 ...
##  $ penscale         :function (x)
##  $ model            :Formal class 'grpl.model' [package "grplasso"] with 8 slots
##   .. ..@ invlink  :function (eta)
##   .. ..@ link     :function (mu)
##   .. ..@ nloglik  :function (y, eta, weights, ...)
##   .. ..@ ngradient:function (x, y, mu, weights, ...)
```

```
##   .. ..@ nhessian :function (x, mu, weights, ...)
##   .. ..@ check    :function (y)
##   .. ..@ name     : chr "Linear Regression Model"
##   .. ..@ comment  : chr "Use update.hess=\"lambda\" in grpl.control because the Hessian is constant"
##  $ ngradient        : num [1:77, 1:18] 1.86e-10 -8.91e+04 -3.05e+04 8.81e+04 2.47e+04 ...
##   ..- attr(*, "dimnames")=List of 2
##   .. ..$ : chr [1:77] "Intercept" "wfl" "rooms" "bj1924" ...
##   .. ..$ : chr [1:18] "89096.8420767937" "44548.4210383969" "22274.2105191984" "11137.1052595992" ..
##  $ nloglik          : num [1:18] 53814779 49627333 46289384 43432093 42478296 ...
##  $ fitted           : num [1:2053, 1:18] 568 550 538 559 849 ...
##   ..- attr(*, "dimnames")=List of 2
##   .. ..$ : chr [1:2053] "1" "2" "3" "4" ...
##   .. ..$ : chr [1:18] "89096.8420767937" "44548.4210383969" "22274.2105191984" "11137.1052595992" ..
##  $ linear.predictors: num [1:2053, 1:18] 568 550 538 559 849 ...
##   ..- attr(*, "dimnames")=List of 2
##   .. ..$ : chr [1:2053] "1" "2" "3" "4" ...
##   .. ..$ : chr [1:18] "89096.8420767937" "44548.4210383969" "22274.2105191984" "11137.1052595992" ..
##  $ fn.val           : num [1:18] 73186835 62104990 55131271 49833529 46317705 ...
##  $ converged        : logi [1:18] TRUE TRUE TRUE TRUE TRUE TRUE ...
##  $ weights          : num [1:2053] 1 1 1 1 1 1 1 1 1 1 ...
##  $ offset           : num [1:2053] 0 0 0 0 0 0 0 0 0 0 ...
##  $ control          :Formal class 'grpl.control' [package "grplasso"] with 13 slots
##   .. ..@ save.x      : logi FALSE
##   .. ..@ save.y      : logi TRUE
##   .. ..@ update.hess : chr "lambda"
##   .. ..@ update.every: num 3
##   .. ..@ inner.loops : num 10
##   .. ..@ line.search : logi TRUE
##   .. ..@ max.iter    : num 500
##   .. ..@ tol         : num 5e-08
##   .. ..@ lower       : num 0.01
##   .. ..@ upper       : num Inf
##   .. ..@ beta        : num 0.5
##   .. ..@ sigma       : num 0.1
##   .. ..@ trace       : num 0
##  $ call             : language grplasso.default(x = x_mod_group, y = y_mod, index = index_mod, lambda
##  - attr(*, "class")= chr "grplasso"
```

```
##           89096.8420767937 44548.4210383969 22274.2105191984 11137.1052595992
## Intercept       154.214852       126.501135     114.13358695      136.2640288
## wfl               5.959653         6.251501       6.39020983        6.5028660
## rooms             0.000000         0.000000       0.00000000       -2.2867445
## bj1924            0.000000         0.000000     -32.22738509      -70.6055267
## bj1939            0.000000         0.000000     -15.83129826      -34.4847297
## bj1948            0.000000         0.000000     -18.95081206      -38.5146384
## bj1957            0.000000         0.000000      -8.52146031      -18.7204109
## bj1957.5          0.000000         0.000000       3.50333396        8.7099919
## bj1960            0.000000         0.000000       0.06475607        3.4999671
## bj1966            0.000000         0.000000      -5.34944321       -7.7542210
## bj1967            0.000000         0.000000      -1.72380394       -0.1973489
## bj1968            0.000000         0.000000      -3.61756251       -5.6912065
## bj1969            0.000000         0.000000     -18.48338907      -36.5627912
## bj1970            0.000000         0.000000      -7.85279376      -10.8468745
## bj1971            0.000000         0.000000      -1.62318638        1.2262230
```

```
## bj1972          0.000000        0.000000      -3.13949726       -5.0515984
## bj1973          0.000000        0.000000      -3.09763216       -0.3489140
## bj1974          0.000000        0.000000       2.76539868       12.8001409
## bj1975          0.000000        0.000000      -5.50580676       -6.2634619
## bj1976          0.000000        0.000000     -31.87800422      -68.2701894
## bj1977          0.000000        0.000000      14.01530167       41.8653426
## bj1978          0.000000        0.000000      10.87363506       25.6725034
## bj1979          0.000000        0.000000      11.86486760       25.7047538
## bj1980          0.000000        0.000000      12.27513312       28.0337514
## bj1981          0.000000        0.000000      20.10185956       49.1698023
## bj1982          0.000000        0.000000     -10.21520942      -20.2341744
## bj1983          0.000000        0.000000      14.83013962       37.3647892
## bj1984          0.000000        0.000000      13.69704313       37.8656728
## bj1985          0.000000        0.000000      23.16435151       56.5889018
## bj1986          0.000000        0.000000      13.41956568       30.7570236
## bj1987          0.000000        0.000000      10.08808814       24.7445560
## bj1988          0.000000        0.000000      33.34550925       80.4016647
## bj1989          0.000000        0.000000      16.61845094       39.9185636
## bj1990          0.000000        0.000000      42.98208915       95.7885764
## bj1991          0.000000        0.000000      16.43990923       37.3560980
## bj1992          0.000000        0.000000      17.81404489       43.7194173
## bj1993          0.000000        0.000000      18.31054559       45.7804696
## bj1994          0.000000        0.000000      61.27621179      144.0998445
## bj1995          0.000000        0.000000      17.06463190       44.7775186
## bj1996          0.000000        0.000000      26.76686008       66.3470291
## bj1997          0.000000        0.000000      21.87344328       50.5677127
## bj1998          0.000000        0.000000      40.65853863       98.1828775
## bj1998.5        0.000000        0.000000      25.95986092       63.9126159
## bj1999          0.000000        0.000000       7.20184455       19.5979792
## bj2000          0.000000        0.000000      29.93812121       69.5140827
## bj2001          0.000000        0.000000      52.53659822      123.1725369
## bez2            0.000000        0.000000       0.00000000      -15.8484934
## bez3            0.000000        0.000000       0.00000000       -9.6288898
## bez4            0.000000        0.000000       0.00000000      -15.6301813
## bez5            0.000000        0.000000       0.00000000      -17.8875945
## bez6            0.000000        0.000000       0.00000000      -24.4374525
## bez7            0.000000        0.000000       0.00000000      -38.7093775
## bez8            0.000000        0.000000       0.00000000      -28.6389313
## bez9            0.000000        0.000000       0.00000000      -23.7899391
## bez10           0.000000        0.000000       0.00000000      -24.1692434
## bez11           0.000000        0.000000       0.00000000      -39.2456863
## bez12           0.000000        0.000000       0.00000000      -12.2963156
## bez13           0.000000        0.000000       0.00000000      -10.5787908
## bez14           0.000000        0.000000       0.00000000      -44.3406735
## bez15           0.000000        0.000000       0.00000000      -26.6689664
## bez16           0.000000        0.000000       0.00000000      -42.2654546
## bez17           0.000000        0.000000       0.00000000      -32.1385585
## bez18           0.000000        0.000000       0.00000000      -14.5844887
## bez19           0.000000        0.000000       0.00000000      -24.8958040
## bez20           0.000000        0.000000       0.00000000      -31.5347682
## bez21           0.000000        0.000000       0.00000000      -27.1898316
## bez22           0.000000        0.000000       0.00000000      -37.8765254
## bez23           0.000000        0.000000       0.00000000      -42.0507679
## bez24           0.000000        0.000000       0.00000000      -41.2386805
```

```
## bez25             0.000000         0.000000       0.00000000      -35.1459270
## wohngut           8.163248        30.570256      40.32516046       35.6547483
## wohnbest         19.404027        89.951630     122.11239198      125.6219395
## ww0             -95.826876      -138.401859    -158.07736120     -166.2292278
## zh0             -61.649992       -78.130303     -82.74632112      -83.8039255
## badkach0         -4.546501       -26.041411     -33.64356569      -34.1704169
## badextra         17.092721        38.078376      44.00083786       45.4417096
## kueche           73.410295       101.003608     106.69375904      103.8807869
##           5568.55262979961 2784.2763148998 1392.1381574499 696.069078724951
## Intercept      151.4291357     157.5577663      160.130058       161.276761
## wfl              6.7021529       6.8084834        6.863998         6.892380
## rooms           -7.5468424     -10.2087856      -11.554971       -12.231766
## bj1924         -87.0200548     -94.1133873      -97.268358       -98.731228
## bj1939         -43.2734554     -47.3491661      -49.266282       -50.188557
## bj1948         -43.5325668     -44.2955397      -44.104937       -43.847554
## bj1957         -22.5201604     -23.7431609      -24.098099       -24.198532
## bj1957.5        12.8396136      15.4956988       17.024433        17.846419
## bj1960           9.4377763      13.8563511       16.529889        17.996931
## bj1966          -3.7594562       0.2004697        2.815886         4.302593
## bj1967           5.6392428      10.6106612       13.764451        15.529508
## bj1968          -2.5467248       0.9125517        3.284385         4.654558
## bj1969         -39.5771079     -38.5295345      -37.156283       -36.227730
## bj1970          -5.1079086       0.3908880        3.960662         5.972655
## bj1971           8.6290073      14.6538689       18.411906        20.499822
## bj1972          -2.9666025      -0.4569078        1.303620         2.329803
## bj1973           7.5790356      13.9021840       17.790057        19.933634
## bj1974          24.8563577      33.2643763       38.205526        40.879972
## bj1975          -0.1558692       5.2041329        8.609554        10.514016
## bj1976         -80.5616395     -84.5705057      -85.864934       -86.310080
## bj1977          66.4202496      81.1709587       89.189116        93.360545
## bj1978          34.1526833      38.8355095       41.366328        42.692049
## bj1979          35.2079068      41.7676220       45.686932        47.832028
## bj1980          37.7426984      43.4386232       46.574356        48.225035
## bj1981          67.0899020      77.2744349       82.748316        85.591518
## bj1982         -21.1683757     -19.9465585      -18.773820       -18.028000
## bj1983          53.4321078      63.3251762       68.852539        71.776752
## bj1984          56.3373232      67.7486751       74.109195        77.468090
## bj1985          78.5394175      91.4227330       98.436235       102.097473
## bj1986          42.5202283      50.0820382       54.432689        56.770351
## bj1987          34.9868437      41.4466689       45.113474        47.069486
## bj1988         110.5970262     128.2066243      137.777676       142.772602
## bj1989          55.8751742      65.8489484       71.494977        74.504404
## bj1990         123.6133752     138.4805532      146.251585       150.234786
## bj1991          51.1613452      60.2281405       65.500751        68.348021
## bj1992          61.9492563      73.2862936       79.652552        83.028143
## bj1993          65.0697639      76.8034241       83.316630        86.751118
## bj1994         190.3370696     214.5798979      226.970194       233.230221
## bj1995          64.9050056      76.8392309       83.313492        86.680552
## bj1996          91.8593079     106.7501364      114.845603       119.071231
## bj1997          67.5587614      77.5064683       82.971852        85.844640
## bj1998         134.2718074     154.7270952      165.643245       171.283148
## bj1998.5        88.8245751     103.2135627      110.954082       114.967221
## bj1999          30.0361180      37.4844801       41.954596        44.401620
## bj2000          92.8859097     105.9901730      112.976940       116.588756
```

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## bj2001          166.7826153     191.4995833      204.715441       211.552570
## bez2            -26.6265278     -31.5521957      -33.839845       -34.932368
## bez3            -13.8413899     -15.2317210      -15.788831       -16.040787
## bez4            -25.3374236     -29.9219005      -32.193607       -33.332252
## bez5            -29.1353161     -34.0859613      -36.353832       -37.431364
## bez6            -42.0015707     -50.7068547      -55.003617       -57.132962
## bez7            -68.9705613     -85.1147338      -93.461059       -97.705763
## bez8            -48.3332287     -57.3470793      -61.514790       -63.496057
## bez9            -38.8639834     -45.7086523      -48.945340       -50.517162
## bez10           -42.8438948     -52.9829248      -58.311473       -61.048605
## bez11           -68.3601732     -83.4129662      -91.076237       -94.944285
## bez12           -21.6628493     -26.6935787      -29.322313       -30.668814
## bez13           -23.2081280     -31.6372835      -36.459075       -39.030997
## bez14           -79.0458639     -97.2418823     -106.507907      -111.177275
## bez15           -52.4979173     -67.8749448      -76.229291       -80.579555
## bez16           -74.6527034     -91.6649361     -100.387306      -104.804551
## bez17           -54.7010788     -65.8851814      -71.451511       -74.228911
## bez18           -25.8885561     -32.1723565      -35.530518       -37.271595
## bez19           -44.6189557     -55.5267581      -61.315924       -64.304364
## bez20           -55.6037254     -68.6264080      -75.472458       -78.991795
## bez21           -49.0170865     -60.8002448      -66.921935       -70.042532
## bez22           -68.1730714     -84.7488027      -93.457121       -97.925052
## bez23           -77.0483931     -96.3433883     -106.457775      -111.633385
## bez24           -75.6737375     -94.5268227     -104.347400      -109.353401
## bez25           -59.6639032     -71.8164116      -77.879048       -80.910123
## wohngut          30.3770056      27.6371783       26.267790        25.587585
## wohnbest        124.2674459     123.6934858      123.457820       123.356533
## ww0            -169.7384701    -171.4485319     -172.279084      -172.686215
## zh0             -83.8317960     -83.4193391      -83.075010       -82.863918
## badkach0        -34.2655501     -34.3593987      -34.419537       -34.453266
## badextra         46.8292653      47.6717663       48.135299        48.378952
## kueche          102.7367655     102.2625163      102.052539       101.955109
##           348.034539362475 174.017269681238 87.0086348406189 43.5043174203094
## Intercept       161.810678      162.067539       162.195972       162.256123
## wfl               6.906812        6.914088         6.917662         6.919566
## rooms           -12.572704      -12.743786       -12.827936       -12.872311
## bj1924          -99.431505      -99.773568       -99.942839      -100.026598
## bj1939          -50.639422      -50.862179       -50.973234       -51.028081
## bj1948          -43.675031      -43.577499       -43.526778       -43.499564
## bj1957          -24.227005      -24.235583       -24.239186       -24.239586
## bj1957.5         18.273519       18.491220        18.600390        18.656237
## bj1960           18.765802       19.159309        19.357389        19.458288
## bj1966            5.093970        5.501994         5.708382         5.813272
## bj1967           16.462564       16.942063        17.184224        17.307194
## bj1968            5.389662        5.770104         5.962613         6.060905
## bj1969          -35.698742      -35.417587       -35.273301       -35.199567
## bj1970            7.038597        7.586905         7.864447         8.004687
## bj1971           21.599421       22.163492        22.448497        22.592643
## bj1972            2.882476        3.169027         3.314236         3.388267
## bj1973           21.057960       21.633538        21.924228        22.070906
## bj1974           42.271061       42.980384        43.338005        43.518211
## bj1975           11.520012       12.036779        12.297828        12.430192
## bj1976          -86.477912      -86.547738       -86.580181       -86.594118
## bj1977           95.487625       96.561514        97.100391        97.371388
```

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## bj1978          43.372691       43.717689       43.890393       43.978292
## bj1979          48.954558       49.528724       49.818633       49.964909
## bj1980          49.072858       49.502566       49.718447       49.827269
## bj1981          87.041057       87.772988       88.140692       88.324936
## bj1982         -17.612208      -17.393288      -17.281699      -17.224407
## bj1983          73.281259       74.044348       74.428165       74.621242
## bj1984          79.194310       80.069346       80.509510       80.730656
## bj1985         103.968423      104.914143      105.389126      105.627728
## bj1986          57.982549       58.599802       58.910896       59.067526
## bj1987          48.080438       48.594351       48.852692       48.983267
## bj1988         145.324928      146.615072      147.263214      147.588619
## bj1989          76.058895       76.848922       77.246588       77.446842
## bj1990         152.252963      153.268902      153.778055      154.033732
## bj1991          69.827908       70.582313       70.962784       71.154289
## bj1992          84.766663       85.648869       86.092714       86.316022
## bj1993          88.515309       89.409389       89.858885       90.085014
## bj1994         236.376140      237.953023      238.742269      239.137206
## bj1995          88.396876       89.263253       89.698320       89.916459
## bj1996         121.230384      122.321781      122.870354      123.145315
## bj1997          87.318534       88.065122       88.440395       88.629067
## bj1998         174.149956      175.595198      176.320355      176.684113
## bj1998.5       117.010462      118.041319      118.558650      118.818303
## bj1999          45.681647       46.336189       46.666686       46.833254
## bj2000         118.425718      119.352099      119.816889      120.050179
## bj2001         215.030825      216.785070      217.665203      218.107200
## bez2           -35.464381      -35.726710      -35.857388      -35.921815
## bez3           -16.160517      -16.218971      -16.248546      -16.262232
## bez4           -33.902984      -34.188846      -34.332257      -34.403475
## bez5           -37.954895      -38.212789      -38.341351      -38.404554
## bez6           -58.191393      -58.718968      -58.983118      -59.113945
## bez7           -99.845570     -100.919889     -101.458870     -101.727542
## bez8           -64.457960      -64.931446      -65.167064      -65.283265
## bez9           -51.290656      -51.674314      -51.866197      -51.960760
## bez10          -62.435624      -63.133879      -63.484931      -63.659668
## bez11          -96.886565      -97.859813      -98.348034      -98.590707
## bez12          -31.350067      -31.692754      -31.865081      -31.950672
## bez13          -40.357692      -41.031349      -41.371289      -41.541110
## bez14         -113.519284     -114.692034     -115.279786     -115.572342
## bez15          -82.797661      -83.917551      -84.481195      -84.762226
## bez16         -107.026551     -108.140932     -108.699782     -108.978195
## bez17          -75.615522      -76.308331      -76.655373      -76.827787
## bez18          -38.157926      -38.605167      -38.830479      -38.942421
## bez19          -65.822634      -66.587942      -66.972759      -67.164637
## bez20          -80.776192      -81.674779      -82.126551      -82.351504
## bez21          -71.617171      -72.408115      -72.805319      -73.002925
## bez22         -100.187872     -101.326637     -101.898485     -102.183951
## bez23         -114.250006     -115.565540     -116.225979     -116.555369
## bez24         -111.879004     -113.147406     -113.783838     -114.101163
## bez25          -82.425227      -83.182740      -83.562278      -83.750876
## wohngut         25.249013       25.080188       24.996053       24.953759
## wohnbest       123.309947      123.287731      123.277422      123.271584
## ww0           -172.887539     -172.987587     -173.037097     -173.061942
## zh0            -82.747899      -82.687205      -82.656478      -82.640698
## badkach0       -34.471094      -34.480258      -34.484913      -34.487250
```

```
## badextra         48.503304        48.566145        48.598371        48.613653
## kueche          101.908196       101.885211       101.874074       101.868245
##           21.7521587101547 10.8760793550774 5.43803967753868 2.71901983876934
## Intercept       162.285363       162.299679       162.306724       162.308935
## wfl               6.920544         6.921044         6.921301         6.921458
## rooms           -12.895017       -12.906623       -12.912573       -12.916028
## bj1924         -100.068303      -100.089141      -100.099609      -100.104517
## bj1939          -51.055357       -51.068949       -51.075737       -51.078941
## bj1948          -43.485588       -43.478518       -43.475007       -43.472586
## bj1957          -24.239494       -24.239362       -24.239291       -24.238811
## bj1957.5         18.684420        18.698590        18.705681        18.709656
## bj1960           19.509111        19.534612        19.547340        19.554371
## bj1966            5.866039         5.892454         5.905579         5.912862
## bj1967           17.369041        17.400011        17.415422        17.423912
## bj1968            6.110443         6.135272         6.147618         6.154625
## bj1969          -35.162413       -35.143858       -35.134724       -35.129391
## bj1970            8.075065         8.110225         8.127660         8.137124
## bj1971           22.665019        22.701212        22.719194        22.728933
## bj1972            3.425542         3.444193         3.453437         3.458731
## bj1973           22.144471        22.181224        22.199470        22.209311
## bj1974           43.608551        43.653691        43.676129        43.688101
## bj1975           12.496716        12.530005        12.546555        12.555645
## bj1976          -86.600647       -86.603843       -86.605517       -86.605427
## bj1977           97.507199        97.575148        97.609043        97.626567
## bj1978           44.022532        44.044728        44.055822        44.062039
## bj1979           50.038298        50.074994        50.093240        50.102934
## bj1980           49.881834        49.909118        49.922699        49.929954
## bj1981           88.417086        88.463079        88.485945        88.497826
## bj1982          -17.195486       -17.181014       -17.173870       -17.169601
## bj1983           74.717979        74.766327        74.790391        74.803058
## bj1984           80.841395        80.896715        80.924235        80.938658
## bj1985          105.747209       105.806918       105.836655       105.852178
## bj1986           59.146020        59.185223        59.204685        59.215044
## bj1987           49.048809        49.081614        49.097968        49.106801
## bj1988          147.751552       147.832990       147.873572       147.894562
## bj1989           77.547217        77.597391        77.622362        77.635586
## bj1990          154.161762       154.225777       154.257701       154.274248
## bj1991           71.250268        71.298237        71.322106        71.334661
## bj1992           86.427924        86.483867        86.511724        86.526328
## bj1993           90.198327        90.254981        90.283207        90.297993
## bj1994          239.334674       239.433320       239.482510       239.507612
## bj1995           90.025609        90.080126        90.107269        90.121310
## bj1996          123.282866       123.351534       123.385687       123.403395
## bj1997           88.723551        88.770736        88.794195        88.806656
## bj1998          176.866191       176.957199       177.002578       177.025923
## bj1998.5        118.948284       119.013238       119.045601       119.062398
## bj1999           46.916746        46.958432        46.979107        46.990256
## bj2000          120.166966       120.225333       120.254422       120.269511
## bj2001          218.328573       218.439298       218.494560       218.522966
## bez2            -35.953819       -35.969742       -35.977676       -35.981471
## bez3            -16.268825       -16.272009       -16.273543       -16.274085
## bez4            -34.438967       -34.456649       -34.465446       -34.469782
## bez5            -38.435912       -38.451487       -38.459218       -38.462872
## bez6            -59.179063       -59.211467       -59.227559       -59.235438
```

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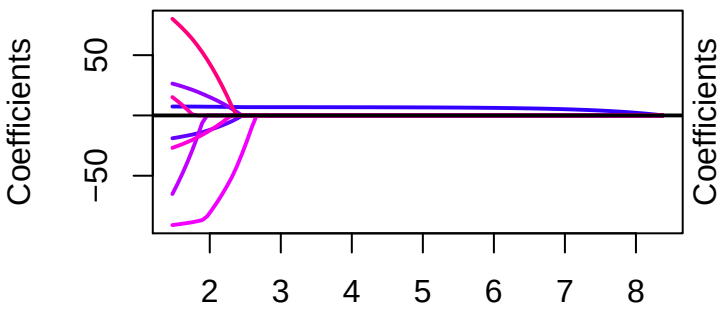
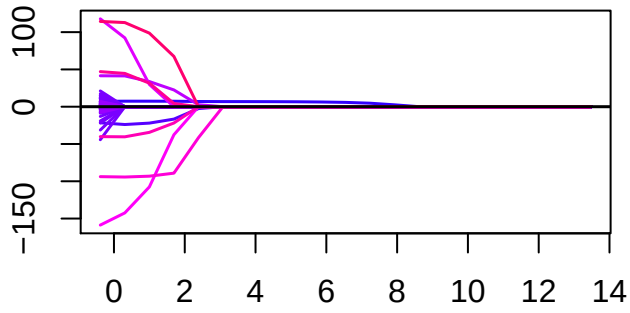
## bez7          -101.861663      -101.928560      -101.961856      -101.978516
## bez8           -65.340991       -65.369700       -65.383979       -65.390863
## bez9           -52.007728       -52.031070       -52.042656       -52.048181
## bez10          -63.746831       -63.790250       -63.811805       -63.822587
## bez11          -98.711692       -98.771962       -98.801911       -98.816760
## bez12          -31.993333       -32.014582       -32.025149       -32.030340
## bez13          -41.625975       -41.668313       -41.689372       -41.699924
## bez14         -115.718299      -115.791080      -115.827313      -115.845308
## bez15          -84.902563       -84.972582       -85.007459       -85.024712
## bez16         -109.117148      -109.186451      -109.220950      -109.238146
## bez17          -76.913731       -76.956550       -76.977835       -76.988344
## bez18          -38.998221       -39.025999       -39.039783       -39.046586
## bez19          -67.260436       -67.308208       -67.331968       -67.343856
## bez20          -82.463741       -82.519680       -82.547491       -82.561367
## bez21          -73.101492       -73.150624       -73.175067       -73.187150
## bez22         -102.326554      -102.397711      -102.433129      -102.450918
## bez23         -116.719856      -116.801923      -116.842784      -116.863176
## bez24         -114.259599      -114.338638      -114.377983      -114.397629
## bez25          -83.844889       -83.891726       -83.915012       -83.926560
## wohngut         24.932561        24.921943        24.916634        24.913917
## wohnbest       123.268521       123.266927       123.266103       123.265470
## ww0           -173.074318      -173.080483      -173.083589      -173.085501
## zh0            -82.632756       -82.628797       -82.626843       -82.625535
## badkach0       -34.488425       -34.489017       -34.489319       -34.489448
## badextra        48.621123        48.624778        48.626558        48.627184
## kueche         101.865286       101.863790       101.863034       101.862518
##           1.35950991938467 0.679754959692335
## Intercept      162.311465       162.311681
## wfl              6.921512         6.921556
## rooms          -12.917378       -12.918315
## bj1924        -100.107633      -100.108629
## bj1939         -51.080846       -51.081547
## bj1948         -43.472460       -43.471512
## bj1957         -24.239196       -24.238890
## bj1957.5        18.711039        18.712212
## bj1960          19.556830        19.558921
## bj1966           5.915175         5.917440
## bj1967          17.426754        17.429339
## bj1968           6.156624         6.158875
## bj1969         -35.128384       -35.126463
## bj1970           8.140273         8.143195
## bj1971          22.732265        22.735236
## bj1972           3.460165         3.461887
## bj1973          22.212728        22.215712
## bj1974          43.692562        43.696078
## bj1975          12.558720        12.561476
## bj1976         -86.607086       -86.606491
## bj1977          97.634095        97.638925
## bj1978          44.064275        44.066064
## bj1979          50.106498        50.109386
## bj1980          49.932742        49.934831
## bj1981          88.502796        88.506102
## bj1982         -17.168837       -17.167299
## bj1983          74.808093        74.811708
```

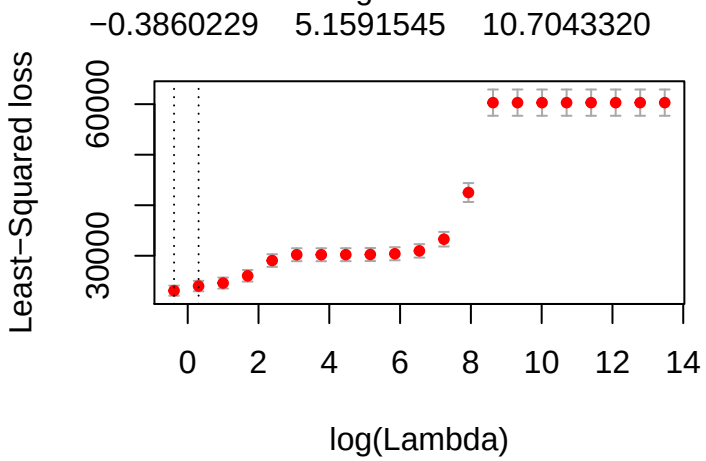
```
## bj1984           80.944439        80.948546
## bj1985          105.858600       105.862943
## bj1986           59.218819        59.221912
## bj1987           49.110073        49.112650
## bj1988          147.903519       147.909314
## bj1989           77.640695        77.644519
## bj1990          154.281429       154.285932
## bj1991           71.339548        71.343184
## bj1992           86.532194        86.536351
## bj1993           90.304021        90.308189
## bj1994          239.519085       239.525732
## bj1995           90.127199        90.131122
## bj1996          123.410758       123.415720
## bj1997           88.811491        88.815068
## bj1998          177.036202       177.042527
## bj1998.5        119.069516       119.074159
## bj1999           46.994194        46.997538
## bj2000          120.275925       120.280090
## bj2001          218.535571       218.543237
## bez2            -35.983551       -35.984450
## bez3            -16.274536       -16.274635
## bez4            -34.471891       -34.473014
## bez5            -38.464830       -38.465732
## bez6            -59.239264       -59.241325
## bez7           -101.986305      -101.990717
## bez8            -65.394455       -65.396163
## bez9            -52.051071       -52.052455
## bez10           -63.827444       -63.830386
## bez11           -98.823756       -98.827697
## bez12           -32.032866       -32.034215
## bez13           -41.704733       -41.707584
## bez14          -115.853966      -115.858649
## bez15           -85.033088       -85.037563
## bez16          -109.246270      -109.250802
## bez17           -76.993337       -76.996122
## bez18           -39.049741       -39.051578
## bez19           -67.349322       -67.352515
## bez20           -82.567847       -82.571530
## bez21           -73.192975       -73.196128
## bez22          -102.459080      -102.463853
## bez23          -116.872777      -116.878165
## bez24          -114.406876      -114.412065
## bez25           -83.932041       -83.935085
## wohngut          24.912696        24.911961
## wohnbest        123.265448       123.265201
## ww0            -173.086350      -173.086750
## zh0             -82.625337       -82.624892
## badkach0        -34.489570       -34.489581
## badextra         48.627711        48.627833
## kueche          101.862423       101.862255
```

In the grouped lasso, the `bj` and `bez` are all shrinked or are all inclueded, respectively. This coincides better with our intuition, that this criterion is considered or not considered. Whereas in the regression and lasso before, just some years of construction and some areas where significant.

.... STILL TO DO BY FB!!!!!








```
## List of 9
##  $ lambda     : num [1:21] 712775 356387 178194 89097 44548 ...
##  $ cvm        : num [1:21] 60304 60304 60304 60304 60304 ...
##  $ cvsd       : num [1:21] 2599 2599 2599 2599 2599 ...
##  $ cvupper    : num [1:21] 62902 62902 62902 62902 62902 ...
##  $ cvlo       : num [1:21] 57705 57705 57705 57705 57705 ...
##  $ name       : Named chr "Least-Squared loss"
##   ..- attr(*, "names")= chr "L2"
##  $ gglasso.fit:List of 9
##   ..$ b0     : Named num [1:21] 570 570 570 570 570 ...
##   .. ..- attr(*, "names")= chr [1:21] "s0" "s1" "s2" "s3" ...
##   ..$ beta   : num [1:76, 1:21] 0 0 0 0 0 0 0 0 0 0 ...
##   .. ..- attr(*, "dimnames")=List of 2
##   .. .. ..$ : chr [1:76] "wfl" "rooms" "bj1924" "bj1939" ...
##   .. .. ..$ : chr [1:21] "s0" "s1" "s2" "s3" ...
##   ..$ df     : Named int [1:21] 0 0 0 0 0 0 0 0 1 1 ...
##   .. ..- attr(*, "names")= chr [1:21] "s0" "s1" "s2" "s3" ...
##   ..$ dim    : int [1:2] 76 21
##   ..$ lambda : num [1:21] 712775 356387 178194 89097 44548 ...
##   ..$ npasses: int 2657
##   ..$ jerr   : int 0
##   ..$ group  : int [1:76] 1 2 3 3 3 3 3 3 3 3 ...
##   ..$ call   : language gglasso(x = x, y = y, group = group, loss = "ls", lambda = lambda, delta = de
##   ..- attr(*, "class")= chr [1:2] "gglasso" "ls"
##  $ lambda.min : num 0.68
##  $ lambda.1se : num 1.36
```

```
##  - attr(*, "class")= chr "cv.gglasso"
```

```
## [1] 1.35951
```

```
##                       s0
## (Intercept)  106.107086
## wfl            7.413067
## rooms        -23.871982
## bj1924         0.000000
## bj1939         0.000000
## bj1948         0.000000
## bj1957         0.000000
## bj1957.5       0.000000
## bj1960         0.000000
## bj1966         0.000000
## bj1967         0.000000
## bj1968         0.000000
## bj1969         0.000000
## bj1970         0.000000
## bj1971         0.000000
## bj1972         0.000000
## bj1973         0.000000
## bj1974         0.000000
## bj1975         0.000000
## bj1976         0.000000
## bj1977         0.000000
## bj1978         0.000000
## bj1979         0.000000
## bj1980         0.000000
## bj1981         0.000000
## bj1982         0.000000
## bj1983         0.000000
## bj1984         0.000000
## bj1985         0.000000
## bj1986         0.000000
## bj1987         0.000000
## bj1988         0.000000
## bj1989         0.000000
## bj1990         0.000000
## bj1991         0.000000
## bj1992         0.000000
## bj1993         0.000000
## bj1994         0.000000
## bj1995         0.000000
## bj1996         0.000000
## bj1997         0.000000
## bj1998         0.000000
## bj1998.5       0.000000
## bj1999         0.000000
## bj2000         0.000000
## bj2001         0.000000
## bez2           0.000000
## bez3           0.000000
## bez4           0.000000
## bez5           0.000000
```

```
## bez6           0.000000
## bez7           0.000000
## bez8           0.000000
## bez9           0.000000
## bez10          0.000000
## bez11          0.000000
## bez12          0.000000
## bez13          0.000000
## bez14          0.000000
## bez15          0.000000
## bez16          0.000000
## bez17          0.000000
## bez18          0.000000
## bez19          0.000000
## bez20          0.000000
## bez21          0.000000
## bez22          0.000000
## bez23          0.000000
## bez24          0.000000
## bez25          0.000000
## wohngut       41.318858
## wohnbest      92.318048
## ww0         -142.415965
## zh0          -94.286712
## badkach0     -40.350166
## badextra      44.631976
## kueche       112.865650
```

```
##                    s0
## (Intercept) 100.907935
## wfl           7.371921
## rooms       -17.563424
## bj1924        0.000000
## bj1939        0.000000
## bj1948        0.000000
## bj1957        0.000000
## bj1957.5      0.000000
## bj1960        0.000000
## bj1966        0.000000
## bj1967        0.000000
## bj1968        0.000000
## bj1969        0.000000
## bj1970        0.000000
## bj1971        0.000000
## bj1972        0.000000
## bj1973        0.000000
## bj1974        0.000000
## bj1975        0.000000
## bj1976        0.000000
## bj1977        0.000000
## bj1978        0.000000
## bj1979        0.000000
## bj1980        0.000000
## bj1981        0.000000
```

```
## bj1982        0.000000
## bj1983        0.000000
## bj1984        0.000000
## bj1985        0.000000
## bj1986        0.000000
## bj1987        0.000000
## bj1988        0.000000
## bj1989        0.000000
## bj1990        0.000000
## bj1991        0.000000
## bj1992        0.000000
## bj1993        0.000000
## bj1994        0.000000
## bj1995        0.000000
## bj1996        0.000000
## bj1997        0.000000
## bj1998        0.000000
## bj1998.5      0.000000
## bj1999        0.000000
## bj2000        0.000000
## bj2001        0.000000
## bez2          0.000000
## bez3          0.000000
## bez4          0.000000
## bez5          0.000000
## bez6          0.000000
## bez7          0.000000
## bez8          0.000000
## bez9          0.000000
## bez10         0.000000
## bez11         0.000000
## bez12         0.000000
## bez13         0.000000
## bez14         0.000000
## bez15         0.000000
## bez16         0.000000
## bez17         0.000000
## bez18         0.000000
## bez19         0.000000
## bez20         0.000000
## bez21         0.000000
## bez22         0.000000
## bez23         0.000000
## bez24         0.000000
## bez25         0.000000
## wohngut      24.120239
## wohnbest      0.000000
## ww0         -48.870443
## zh0         -89.859070
## badkach0    -23.908694
## badextra      8.772584
## kueche       72.633830

## 77 x 3 sparse Matrix of class "dgCMatrix"
```

```
##             group lasso general lasso  vanilla LS
## (Intercept)  106.107086  121.53253762  162.310441
## wfl            7.413067    6.35790480    6.921638
## rooms        -23.871982    .           -12.919931
## bj1924         .         -77.41285147 -100.109344
## bj1939         .           .           -51.082040
## bj1948         .         -39.87004946  -43.469920
## bj1957         .         -12.77226096  -24.238117
## bj1957.5       .           .            18.713838
## bj1960         .           .            19.561674
## bj1966         .          -1.78110003    5.920349
## bj1967         .           .            17.432638
## bj1968         .           .             6.161898
## bj1969         .         -19.07548904  -35.123926
## bj1970         .           .             8.146714
## bj1971         .           .            22.738843
## bj1972         .           .             3.464200
## bj1973         .           .            22.219275
## bj1974         .           .            43.700203
## bj1975         .           .            12.564953
## bj1976         .           .           -86.605034
## bj1977         .           .            97.644285
## bj1978         .           .            44.068520
## bj1979         .           .            50.112745
## bj1980         .           .            49.937326
## bj1981         .           .            88.509713
## bj1982         .           .           -17.165153
## bj1983         .           0.03551727   74.815843
## bj1984         .           .            80.953167
## bj1985         .           5.50490755  105.867818
## bj1986         .           .            59.225499
## bj1987         .           .            49.115827
## bj1988         .          25.05760499  147.915666
## bj1989         .           .            77.648956
## bj1990         .          43.94662766  154.290945
## bj1991         .           .            71.347309
## bj1992         .           .            86.541067
## bj1993         .          12.74643665   90.312924
## bj1994         .         125.34863498  239.532748
## bj1995         .           .            90.135389
## bj1996         .          17.20771477  123.421116
## bj1997         .           .            88.819228
## bj1998         .          51.01474230  177.049378
## bj1998.5       .          34.40462157  119.079298
## bj1999         .           .            47.001514
## bj2000         .          26.95792991  120.284699
## bj2001         .          33.21189163  218.551590
## bez2           .           .           -35.985131
## bez3           .           .           -16.274425
## bez4           .           .           -34.474015
## bez5           .           .           -38.466358
## bez6           .           .           -59.243092
## bez7           .           .          -101.994969
## bez8           .           .           -65.397522
```

```
## bez9           .           .           -52.053469
## bez10          .           .           -63.833161
## bez11          .           .           -98.831306
## bez12          .           .           -32.035394
## bez13          .           8.87285870  -41.710326
## bez14          .           .          -115.863027
## bez15          .           .           -85.041679
## bez16          .          -5.64277000 -109.255107
## bez17          .           .           -76.998642
## bez18          .           .           -39.053201
## bez19          .           .           -67.355571
## bez20          .           .           -82.574987
## bez21          .           .           -73.198994
## bez22          .           .          -102.468535
## bez23          .           .          -116.883323
## bez24          .           .          -114.417039
## bez25          .           .           -83.937882
## wohngut       41.318858   35.58541690   24.911148
## wohnbest      92.318048  105.40971577  123.264686
## ww0         -142.415965 -148.97130968 -173.087458
## zh0          -94.286712  -78.75042575  -82.624164
## badkach0     -40.350166  -30.32923639  -34.489575
## badextra      44.631976   38.13432987   48.627634
## kueche       112.865650  103.33736726  101.861941
```