final.model

Edward J. Lee

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Usual Data Cleaning

```r
library(NHANES)   # NHANES dataset
library(dplyr)    # Data wrangling
library(ggplot2) # Visualization
library(car)      # Multicollinearity check (VIF)
library(ggResidpanel) # Advanced diagnostic plots
library(knitr) #for kable
library(gridExtra) #for scatterplot matrix

# if you don't have it installed, do install_packages("NHANES")
data("NHANES")
nrow(NHANES) #10,000 observations
```

```
## [1] 10000
```

```r
# remove babies (ages 0-3)
nhanes_filtered <- NHANES %>% filter(Age > 20)
nrow(nhanes_filtered) #7094 observations
```

```
## [1] 7094
```

```r
# remove NA entries and only select columns of interest
nhanes_data <- nhanes_filtered %>%
  dplyr::select(Height, Age, Weight, BPSysAve, BPDiaAve,
                TotChol, SmokeNow, PhysActiveDays) %>%
  na.omit()

# categorical predictors
nhanes_data$SmokeNow <- as.factor(nhanes_data$SmokeNow)
nhanes_data <- data.frame(nhanes_data)

# fit the model
model <- lm(TotChol ~ Age + Weight + Height + BPSysAve + BPDiaAve + SmokeNow +
              PhysActiveDays,
            data = nhanes_data)

n <- nrow(nhanes_data)
```

Box-Cox Transformation and Polynomial Term

```r
#POLYNOMIAL "AGE" TERM
pb_data <- nhanes_data %>%
```
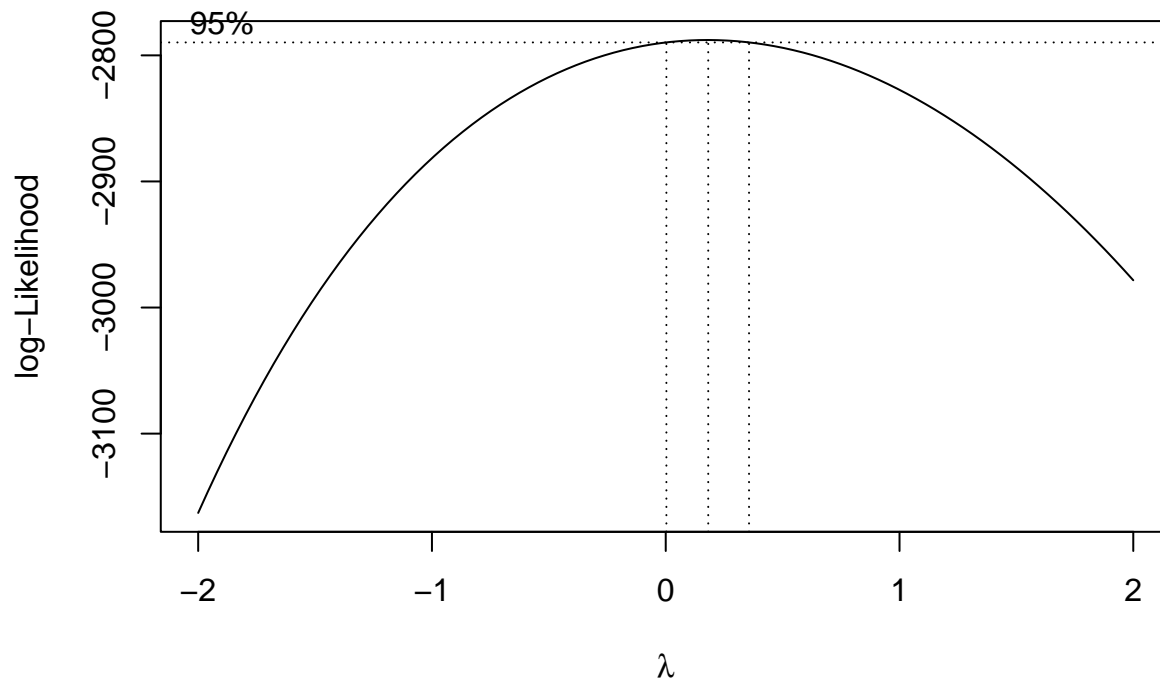
```
  dplyr::select(Height, Age, Weight, BPSysAve, BPDiaAve,
                TotChol, SmokeNow, PhysActiveDays) %>%
  mutate(pb.Age2 = Age^2)

pb_model <- lm(TotChol~Age+pb.Age2+Height+Weight+BPSysAve+BPDiaAve+
                 SmokeNow+PhysActiveDays, data=pb_data)

#BOX COX TRANSFORMATION
library(MASS) #For BOXCOX

pb.b <- boxcox(pb_model)
```



```
pb.lambda <- pb.b$x[which.max(pb.b$y)]

pb.log_product <- sum(log(pb_data$TotChol))
pb.geo_mean <- exp(pb.log_product/n)

pb.TotChol <- pb.geo_mean^(1-pb.lambda)*(pb_data$TotChol^pb.lambda - 1)/pb.lambda


p.BXCX.frame <- pb_data %>%
  dplyr::select(-TotChol) %>%
  mutate(pb.TotChol = pb.TotChol)

p.BXCX.model <- lm(pb.TotChol ~ Age + pb.Age2 + Weight + Height + BPSysAve +
                     BPDiaAve + SmokeNow + PhysActiveDays,
                   data = p.BXCX.frame)

summary(p.BXCX.model)

##
## Call:
```
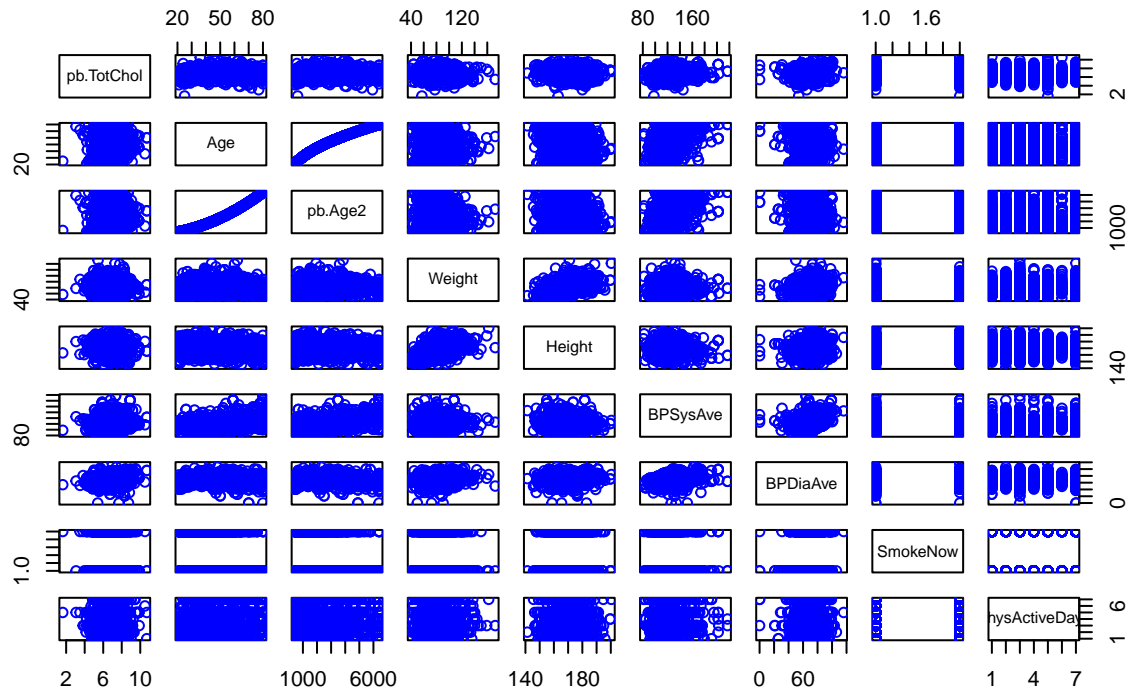
```
## lm(formula = pb.TotChol ~ Age + pb.Age2 + Weight + Height + BPSysAve +
##     BPDiaAve + SmokeNow + PhysActiveDays, data = p.BXCX.frame)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.4892 -0.6298  0.0122  0.6579  3.8580
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     4.3570886  0.5883660   7.405 2.27e-13 ***
## Age             0.1023201  0.0106377   9.619  < 2e-16 ***
## pb.Age2        -0.0009777  0.0001074  -9.107  < 2e-16 ***
## Weight         -0.0007650  0.0016022  -0.477 0.633088
## Height         -0.0078447  0.0032064  -2.447 0.014545 *
## BPSysAve        0.0070900  0.0018160   3.904 9.91e-05 ***
## BPDiaAve        0.0095125  0.0024571   3.871 0.000113 ***
## SmokeNowYes    -0.0196813  0.0575264  -0.342 0.732308
## PhysActiveDays -0.0101337  0.0148490  -0.682 0.495070
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9873 on 1380 degrees of freedom
## Multiple R-squared:  0.1215, Adjusted R-squared:  0.1164
## F-statistic: 23.85 on 8 and 1380 DF,  p-value: < 2.2e-16
```

```r
#FITTED AND RESIDUAL VALUES FROM TRANSFORMED
pb.fitted <- fitted(p.BXCX.model)
pb.residuals <- resid(p.BXCX.model)

#DATA FRAME FOR PLOTTING
pb.plot_data <- data.frame(pb.fitted = pb.fitted, pb.residuals = pb.residuals)

#PAIRWISE PLOTS OF ORIGINAL MODEL
pairs(~pb.TotChol+Age+pb.Age2+Weight+Height+
        BPSysAve+BPDiaAve+SmokeNow+PhysActiveDays,
    data = p.BXCX.frame,
    main = "Pairwise ScatterPlots of Transformed Polynomial Model",
    col = "blue")
```

Pairwise ScatterPlots of Transformed Polynomial Model
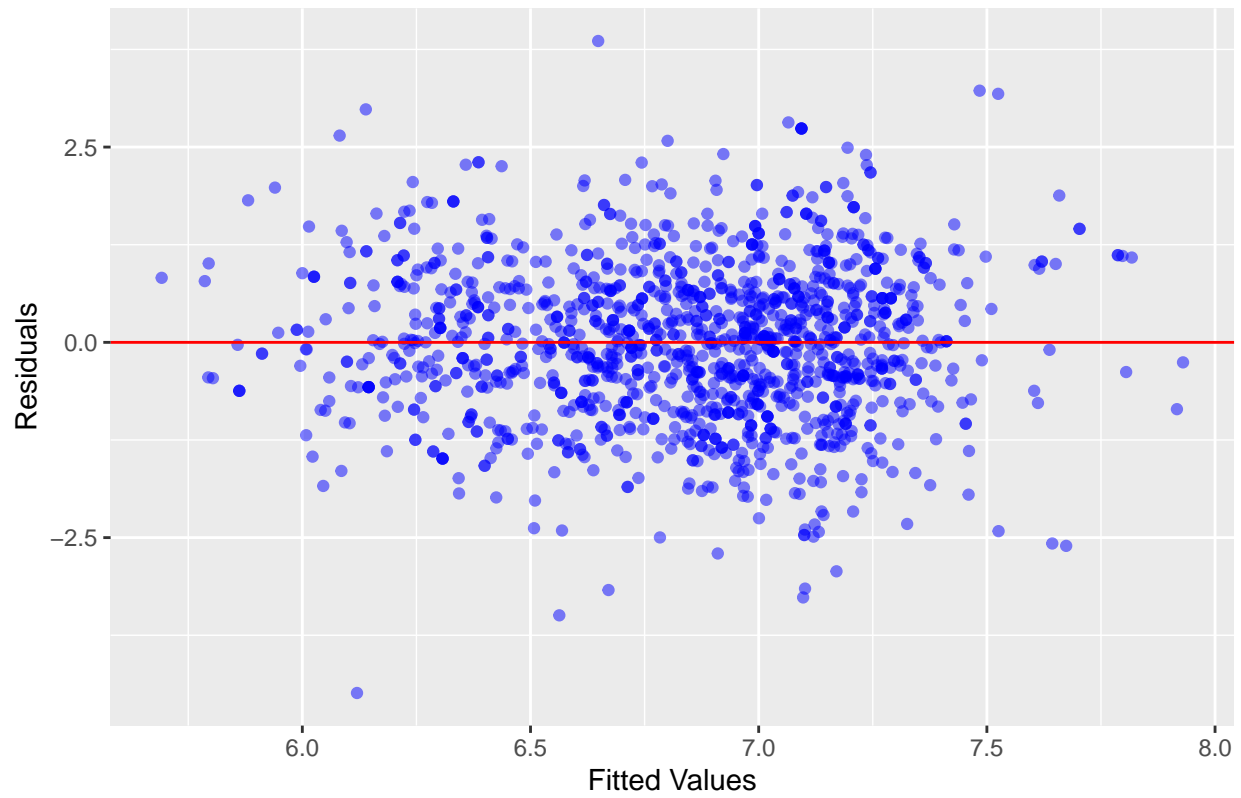

Residual Plots

```
#RESIDUALS VS FITTED
res_fitted_plot <- ggplot(data = pb.plot_data,
                          aes(x = pb.fitted, y = pb.residuals)) +
  geom_point(color = "blue", alpha = 0.5) +
  geom_hline(yintercept = 0, color = "red") +
  labs(title = "Residuals vs Fitted Values (BXCX and Poly)",
       x = "Fitted Values", y = "Residuals")

print(res_fitted_plot)
```
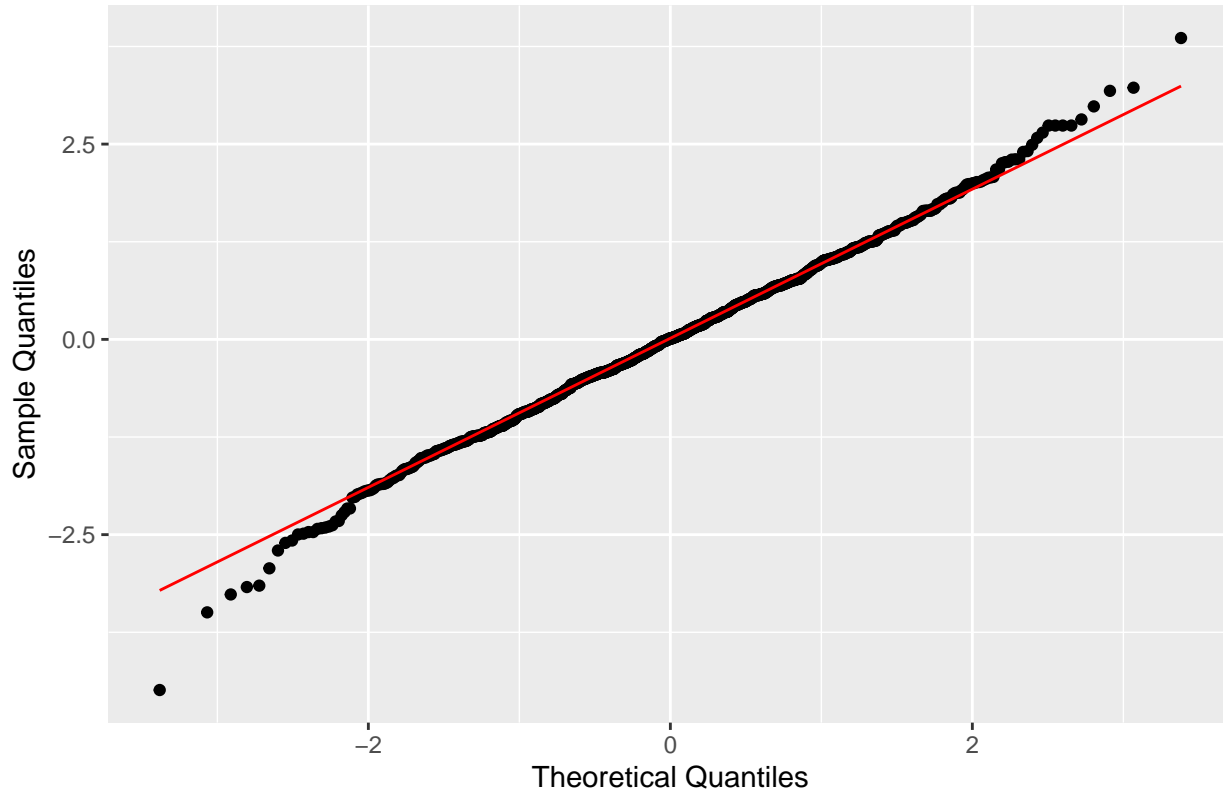
Residuals vs Fitted Values (BXCX and Poly)

```
#NORMAL QQ PLOT
qq_plot <- ggplot(data = data.frame(pb.residuals = pb.residuals),
                  aes(sample = pb.residuals)) +
  stat_qq() +
  stat_qq_line(color = "red") +
  labs(title = "Normal Q-Q Plot (BXCX and Poly)",
       x = "Theoretical Quantiles", y = "Sample Quantiles")

print(qq_plot)
```
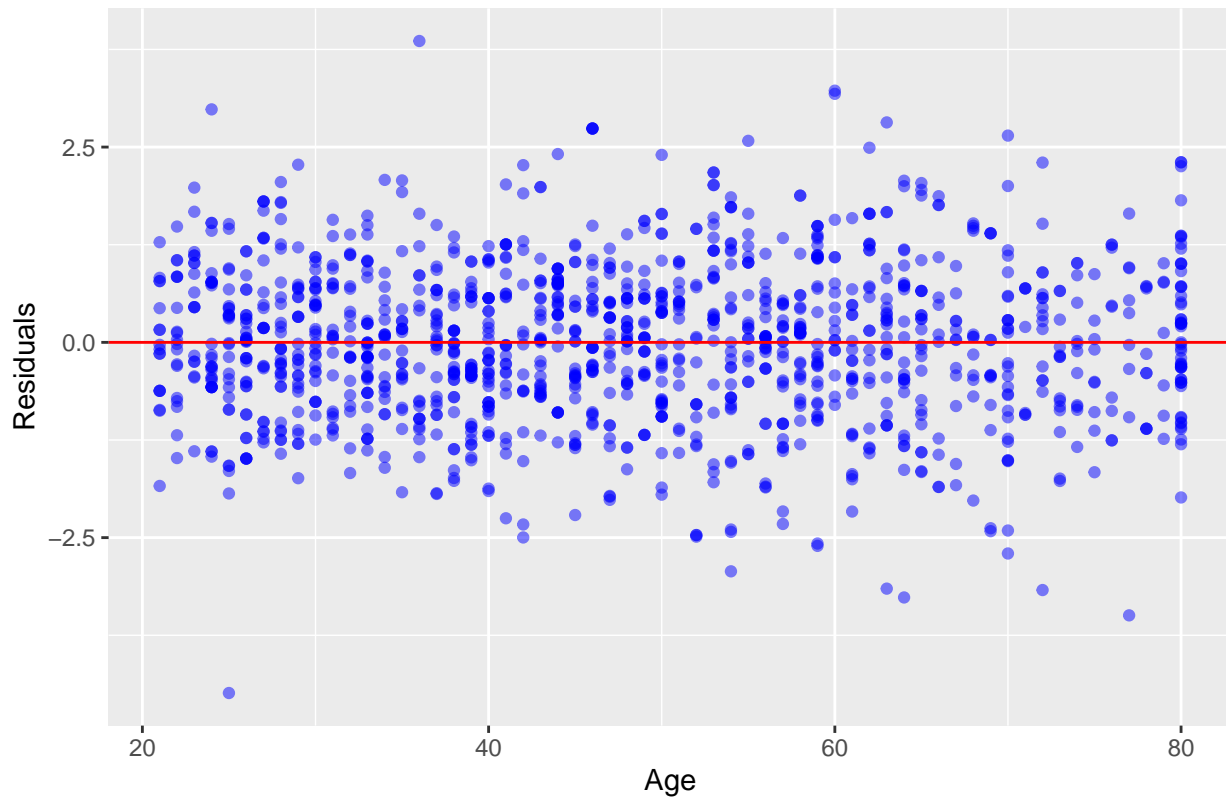
Normal Q–Q Plot (BXCX and Poly)


```
#RESIDUALS VS AGE
res_age_plot <- ggplot(p.BXCX.frame,
                       aes(x = Age, y = pb.residuals)) +
  geom_point(color = "blue", alpha = 0.5) +
  geom_hline(yintercept = 0, color = "red") +
  labs(title = "Residuals vs Age (BXCX and Poly)",
       x = "Age", y = "Residuals")

print(res_age_plot)
```
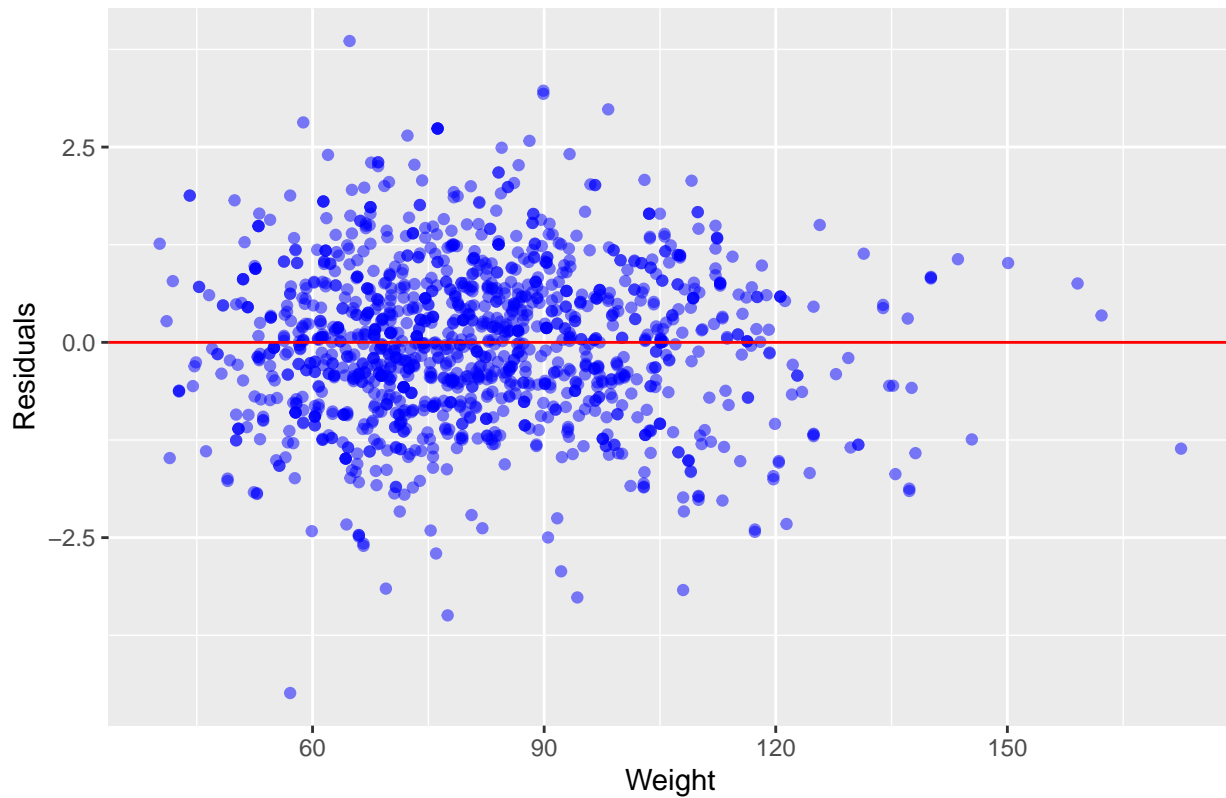
Residuals vs Age (BXCX and Poly)

```r
#RESIDUALS VS WEIGHT
res_weight_plot <- ggplot(p.BXCX.frame,
                          aes(x = Weight, y = pb.residuals)) +
  geom_point(color = "blue", alpha = 0.5) +
  geom_hline(yintercept = 0, color = "red") +
  labs(title = "Residuals vs Weight (BXCX and Poly)",
       x = "Weight", y = "Residuals")

print(res_weight_plot)
```

Residuals vs Weight (BXCX and Poly)
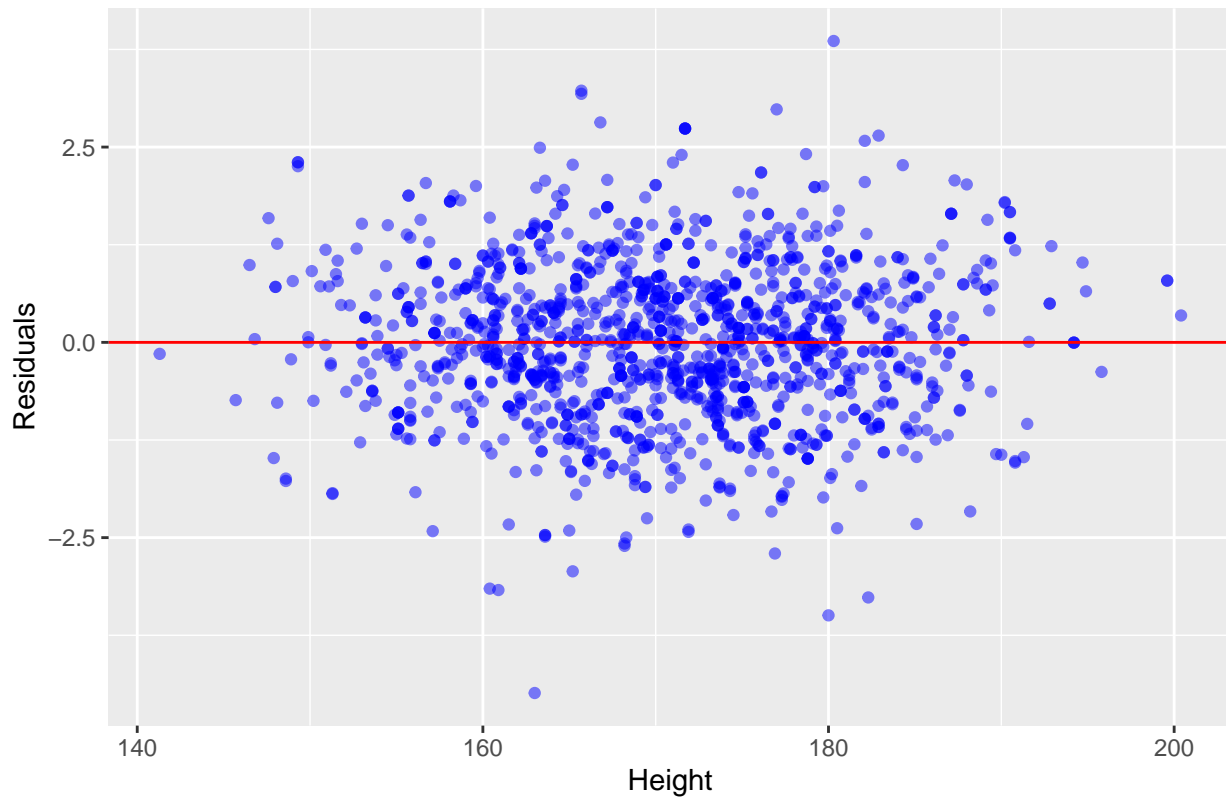


```
#RESIDUALS VS HEIGHT
res_height_plot <- ggplot(p.BXCX.frame,
                          aes(x = Height, y = pb.residuals)) +
  geom_point(color = "blue", alpha = 0.5) +
  geom_hline(yintercept = 0, color = "red") +
  labs(title = "Residuals vs Height (BXCX and Poly)",
       x = "Height", y = "Residuals")

print(res_height_plot)
```
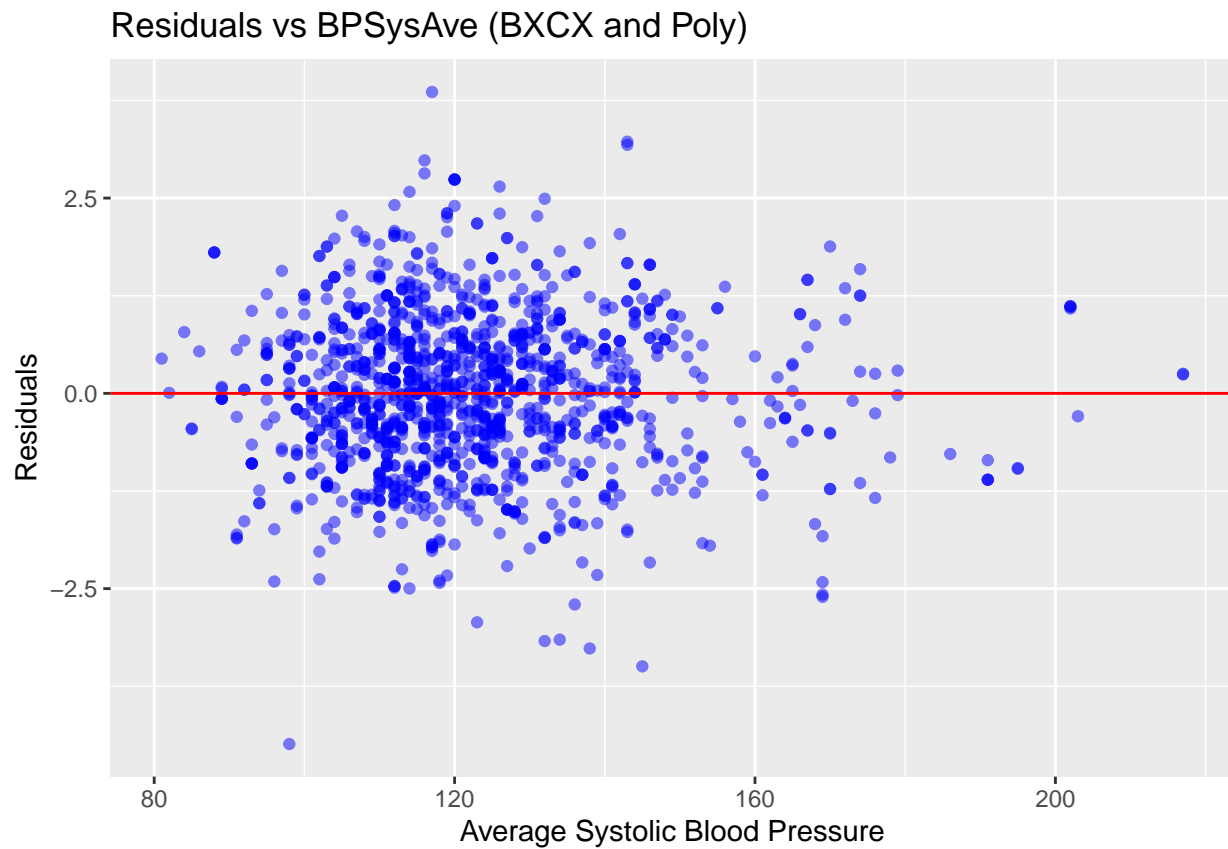
Residuals vs Height (BXCX and Poly)
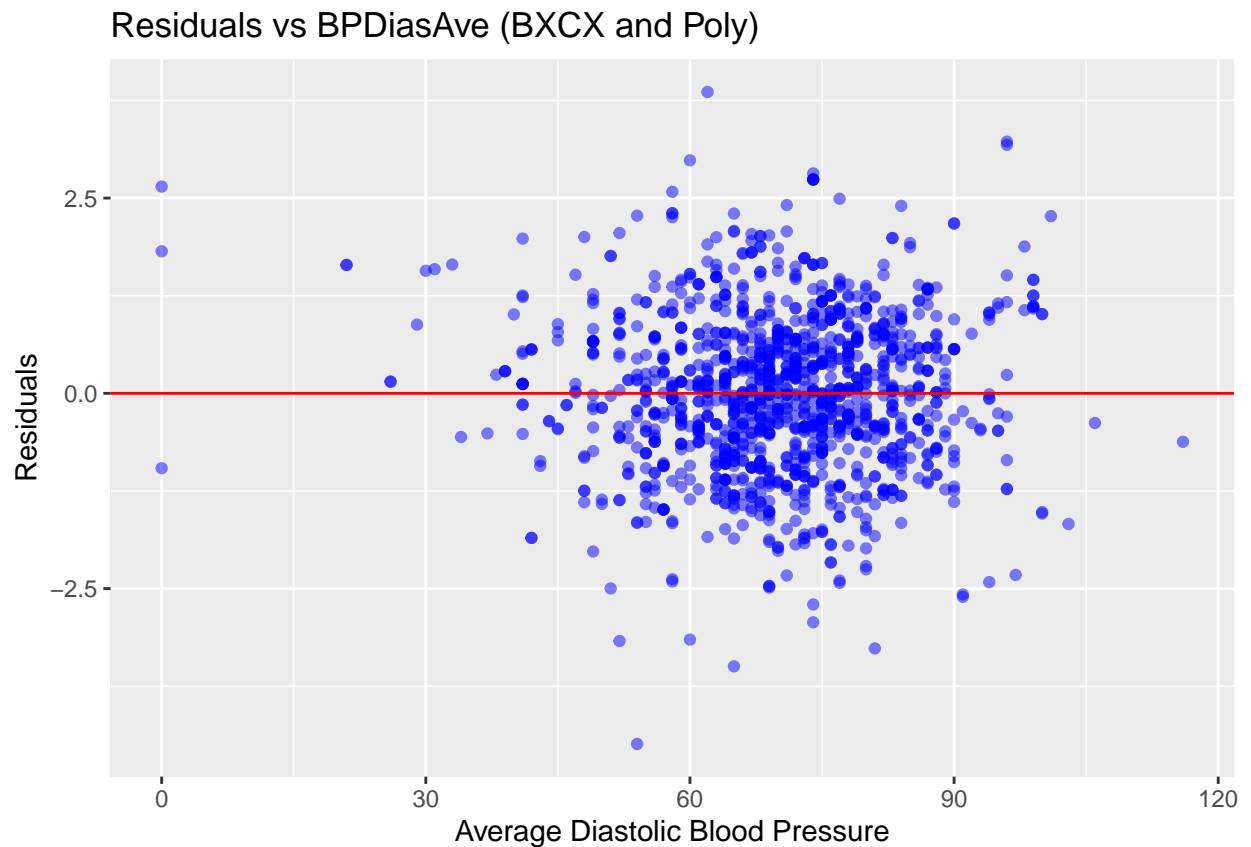


```
#RESIDUALS VS BPSysAve
res_BPSysAve_plot <- ggplot(p.BXCX.frame,
                             aes(x = BPSysAve, y = pb.residuals)) +
  geom_point(color = "blue", alpha = 0.5) +
  geom_hline(yintercept = 0, color = "red") +
  labs(title = "Residuals vs BPSysAve (BXCX and Poly)",
       x = "Average Systolic Blood Pressure", y = "Residuals")

print(res_BPSysAve_plot)
```
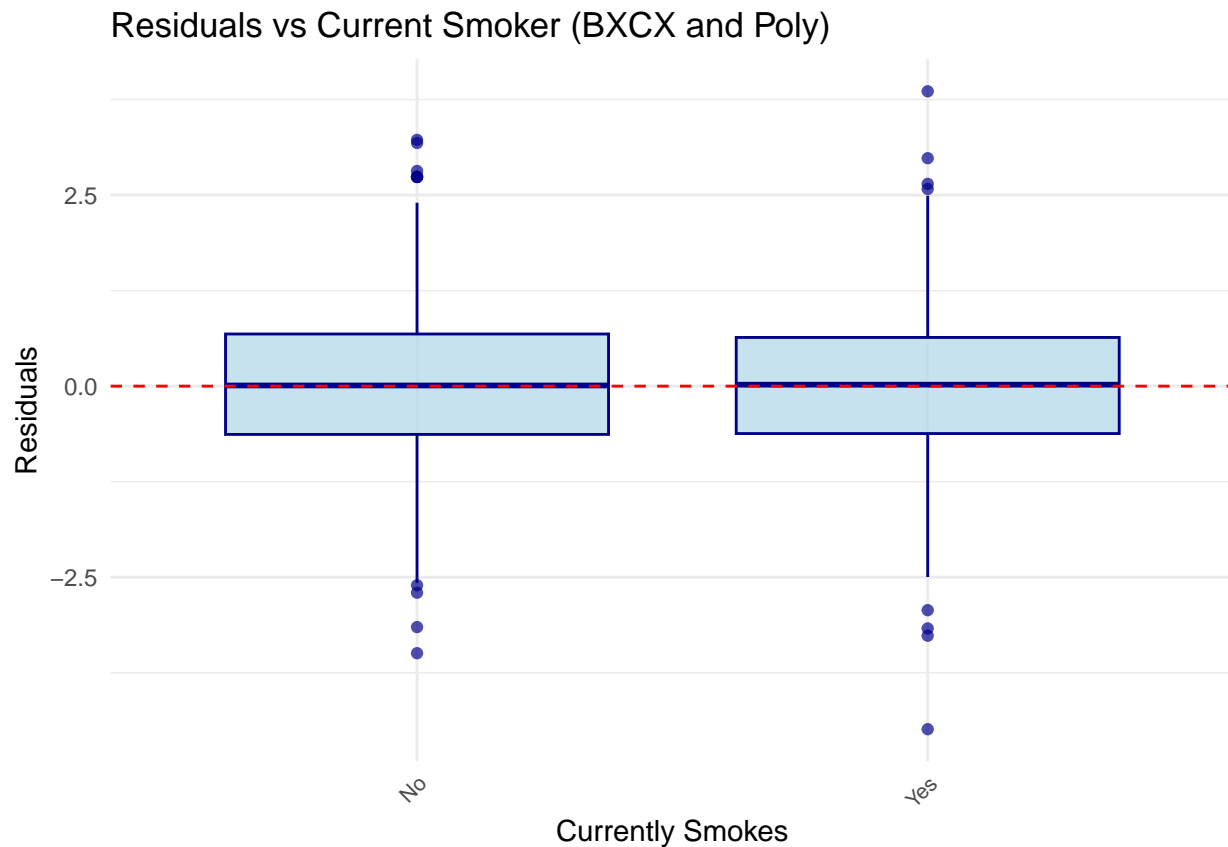
Residuals vs BPSysAve (BXCX and Poly)


```r
#RESIDUALS VS BPDiaAve
res_BPDiaAve_plot <- ggplot(p.BXCX.frame,
                            aes(x = BPDiaAve, y = pb.residuals)) +
  geom_point(color = "blue", alpha = 0.5) +
  geom_hline(yintercept = 0, color = "red") +
  labs(title = "Residuals vs BPDiasAve (BXCX and Poly)",
       x = "Average Diastolic Blood Pressure", y = "Residuals")

print(res_BPDiaAve_plot)
```
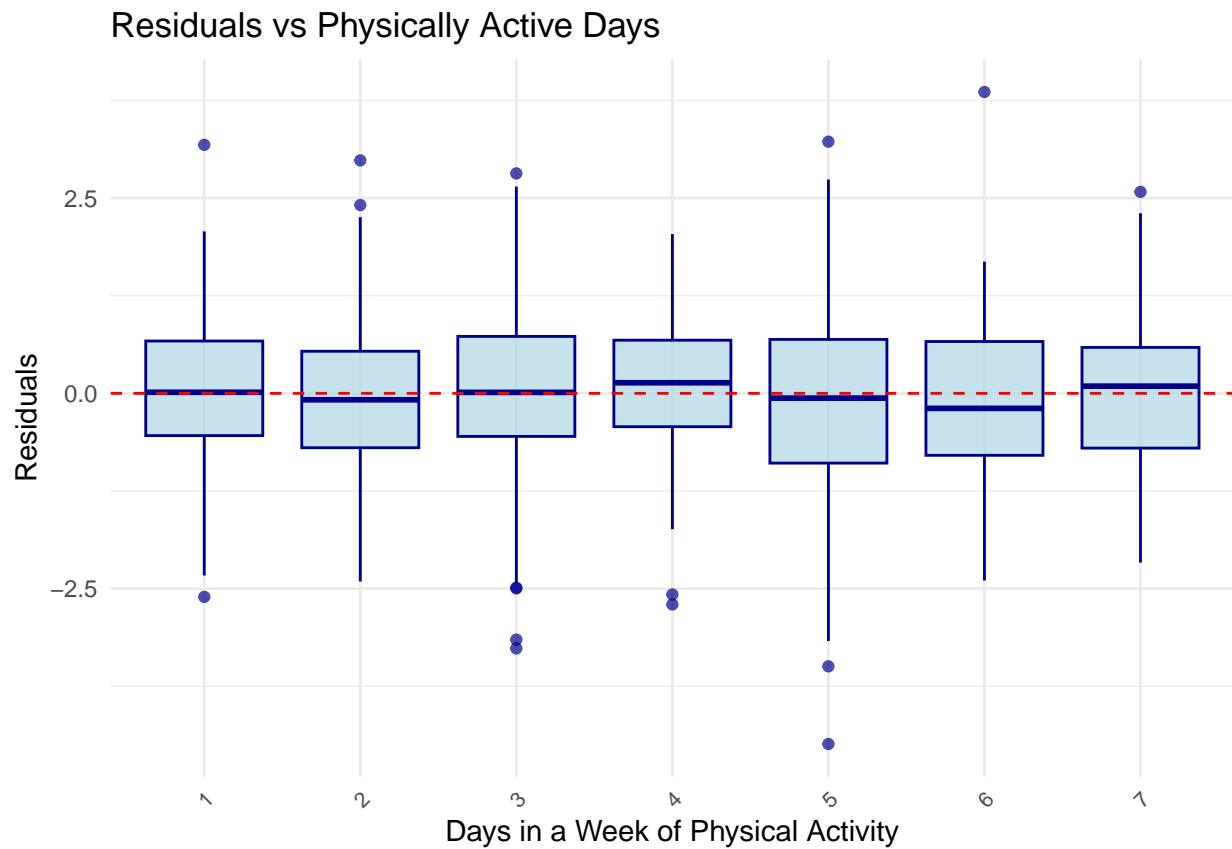
Residuals vs BPDiasAve (BXCX and Poly)


```r
#RESIDUALS VS SmokeNow (BOXPLOT)
res_smoke_plot <- ggplot(
  p.BXCX.frame, aes(x = as.factor(SmokeNow), y = pb.residuals)) +
  geom_boxplot(fill = "lightblue", color = "darkblue", alpha = 0.7) +
  geom_hline(yintercept = 0, color = "red", linetype = "dashed") +
  theme_minimal() +
  ggtitle("Residuals vs Current Smoker (BXCX and Poly)") +
  xlab("Currently Smokes") +
  ylab("Residuals") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 8))

print(res_smoke_plot)
```

Residuals vs Current Smoker (BXCX and Poly)


```
#RESIDUALS VS PhysActiveDays (BOXPLOT)
res_active_plot <- ggplot(
  p.BXCX.frame,
  aes(x = as.factor(PhysActiveDays), y = pb.residuals)) +
  geom_boxplot(fill = "lightblue", color = "darkblue", alpha = 0.7) +
  geom_hline(yintercept = 0, color = "red", linetype = "dashed") +
  theme_minimal() +
  ggtitle("Residuals vs Physically Active Days") +
  xlab("Days in a Week of Physical Activity") +
  ylab("Residuals") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 8))

print(res_active_plot)
```
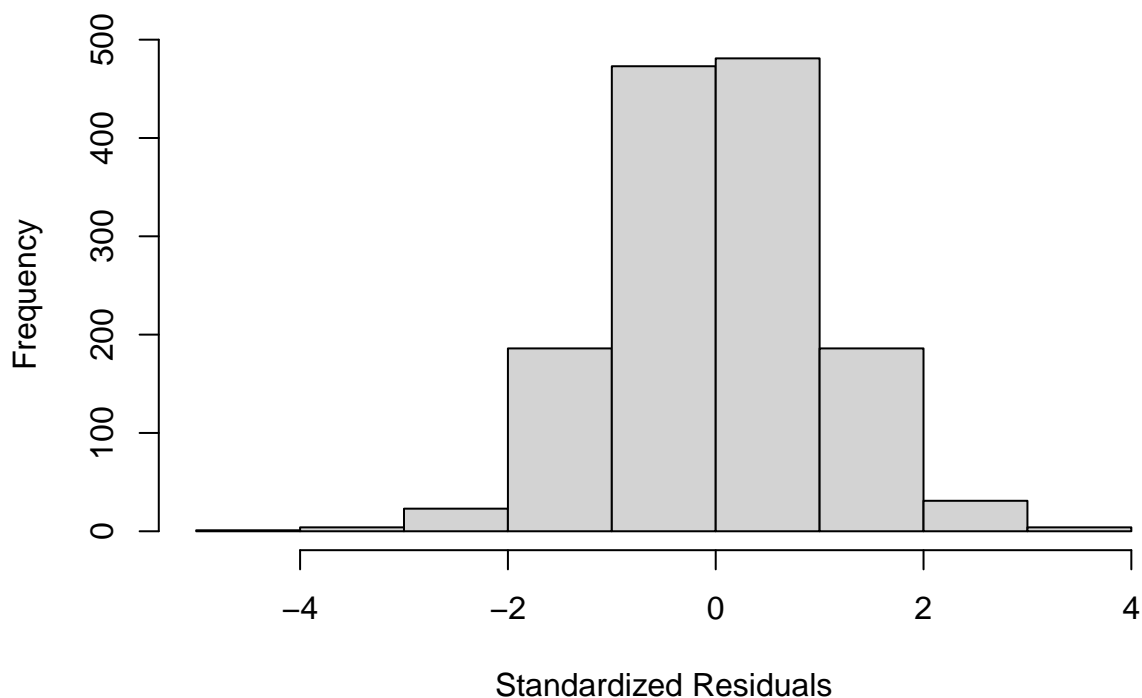
Residuals vs Physically Active Days


```
tr_stres_values <- rstandard(p.BXCX.model)

tr_stres_plot <- hist(tr_stres_values,
                      xlab = "Standardized Residuals",
                      main = "Standardized Residual Histogram")
```

Standardized Residual Histogram


```r
library(leaps)

best_subset_p.BXCX <- regsubsets(pb.TotChol~., data=p.BXCX.frame,nvmax=7,                    nbest=1,real

summary(best_subset_p.BXCX)
```

```
## Subset selection object
## Call: regsubsets.formula(pb.TotChol ~ ., data = p.BXCX.frame, nvmax = 7,
##     nbest = 1, really.big = TRUE, method = "exhaustive")
## 8 Variables  (and intercept)
##                 Forced in Forced out
## Height              FALSE      FALSE
## Age                 FALSE      FALSE
## Weight              FALSE      FALSE
## BPSysAve            FALSE      FALSE
## BPDiaAve            FALSE      FALSE
## SmokeNowYes         FALSE      FALSE
## PhysActiveDays      FALSE      FALSE
## pb.Age2             FALSE      FALSE
## 1 subsets of each size up to 7
## Selection Algorithm: exhaustive
##          Height Age Weight BPSysAve BPDiaAve SmokeNowYes PhysActiveDays pb.Age2
## 1  ( 1 ) " "    " " " "    " "      "*"      " "         " "            " "
## 2  ( 1 ) " "    "*" " "    " "      " "      " "         " "            "*"
## 3  ( 1 ) " "    "*" " "    "*"      " "      " "         " "            "*"
## 4  ( 1 ) " "    "*" " "    "*"      "*"      " "         " "            "*"
## 5  ( 1 ) "*"    "*" " "    "*"      "*"      " "         " "            "*"
## 6  ( 1 ) "*"    "*" " "    "*"      "*"      " "         "*"            "*"
## 7  ( 1 ) "*"    "*" "*"    "*"      "*"      " "         "*"            "*"
```
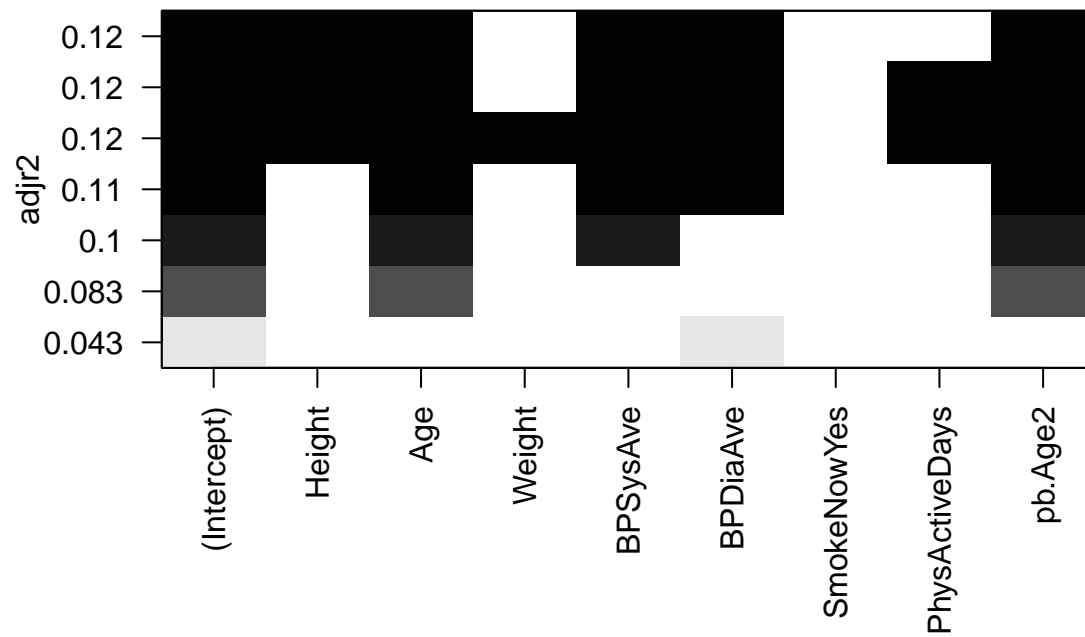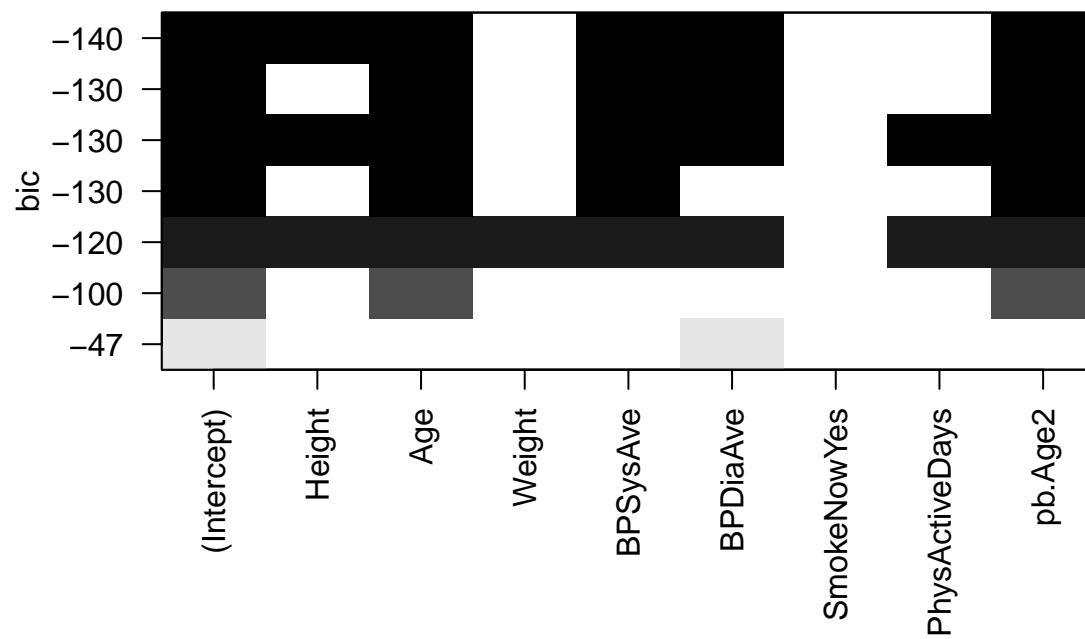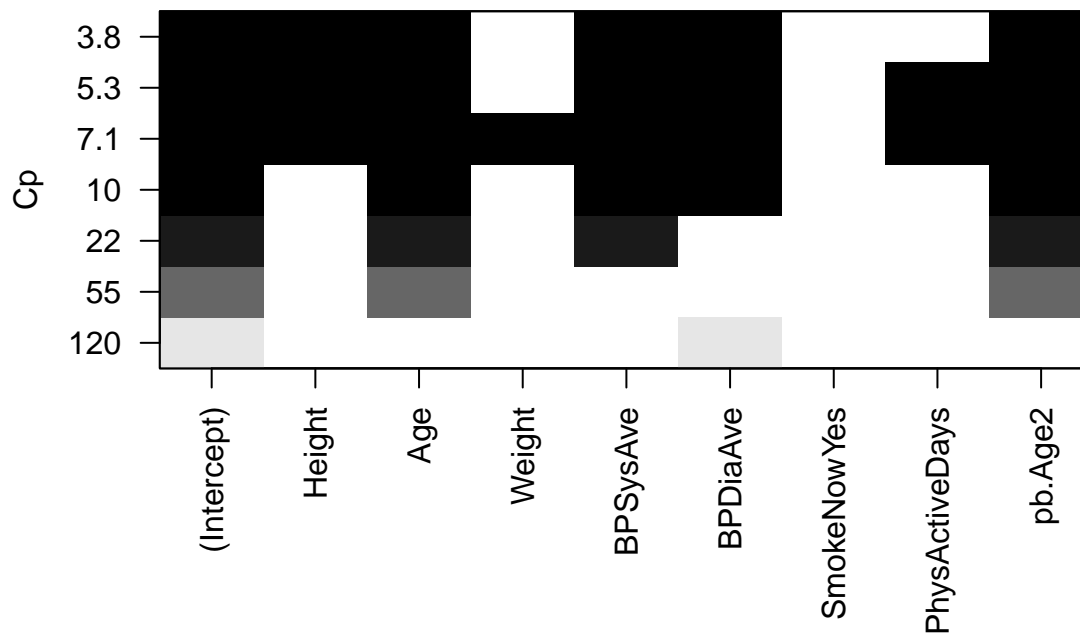
```
plot(best_subset_p.BXCX,scale='adjr2')
```



```
plot(best_subset_p.BXCX,scale='bic');
```



```
plot(best_subset_p.BXCX,scale='Cp')
```

```r
AIC_p.BXCX <- step(p.BXCX.model, direction="both")
```

```
## Start:  AIC=-26.48
## pb.TotChol ~ Age + pb.Age2 + Weight + Height + BPSysAve + BPDiaAve +
##     SmokeNow + PhysActiveDays
##
##                   Df Sum of Sq    RSS     AIC
## - SmokeNow         1     0.114 1345.3 -28.365
## - Weight           1     0.222 1345.4 -28.253
## - PhysActiveDays   1     0.454 1345.7 -28.014
## <none>                         1345.2 -26.482
## - Height           1     5.835 1351.1 -22.471
## - BPDiaAve         1    14.610 1359.8 -13.478
## - BPSysAve         1    14.858 1360.1 -13.225
## - pb.Age2          1    80.843 1426.1  52.579
## - Age              1    90.187 1435.4  61.651
##
## Step:  AIC=-28.36
## pb.TotChol ~ Age + pb.Age2 + Weight + Height + BPSysAve + BPDiaAve +
##     PhysActiveDays
##
##                   Df Sum of Sq    RSS     AIC
## - Weight           1     0.199 1345.5 -30.159
## - PhysActiveDays   1     0.452 1345.8 -29.898
## <none>                         1345.3 -28.365
## + SmokeNow         1     0.114 1345.2 -26.482
## - Height           1     5.833 1351.2 -24.355
## - BPDiaAve         1    14.747 1360.1 -15.222
## - BPSysAve         1    14.765 1360.1 -15.203
## - pb.Age2          1    80.740 1426.1  50.590
## - Age              1    90.533 1435.9  60.096
##
## Step:  AIC=-30.16
## pb.TotChol ~ Age + pb.Age2 + Height + BPSysAve + BPDiaAve + PhysActiveDays
```

```
##
##                  Df Sum of Sq    RSS     AIC
## - PhysActiveDays  1     0.432 1346.0 -31.713
## <none>                         1345.5 -30.159
## + Weight          1     0.199 1345.3 -28.365
## + SmokeNow        1     0.091 1345.4 -28.253
## - Height          1     8.591 1354.1 -23.319
## - BPDiaAve        1    14.551 1360.1 -17.219
## - BPSysAve        1    14.579 1360.1 -17.191
## - pb.Age2         1    80.612 1426.2  48.659
## - Age             1    90.449 1436.0  58.207
##
## Step:  AIC=-31.71
## pb.TotChol ~ Age + pb.Age2 + Height + BPSysAve + BPDiaAve
##
##                  Df Sum of Sq    RSS     AIC
## <none>                         1346.0 -31.713
## + PhysActiveDays  1     0.432 1345.5 -30.159
## + Weight          1     0.179 1345.8 -29.898
## + SmokeNow        1     0.090 1345.9 -29.806
## - Height          1     8.514 1354.5 -24.954
## - BPSysAve        1    14.473 1360.4 -18.858
## - BPDiaAve        1    14.691 1360.7 -18.635
## - pb.Age2         1    80.243 1426.2  46.720
## - Age             1    90.027 1436.0  56.217
```

```r
summary(AIC_p.BXCX)
```

```
##
## Call:
## lm(formula = pb.TotChol ~ Age + pb.Age2 + Height + BPSysAve +
##     BPDiaAve, data = p.BXCX.frame)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.5043 -0.6322  0.0074  0.6457  3.8423
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.3844636  0.5574336   7.865 7.36e-15 ***
## Age          0.1016419  0.0105680   9.618  < 2e-16 ***
## pb.Age2     -0.0009697  0.0001068  -9.080  < 2e-16 ***
## Height      -0.0084564  0.0028590  -2.958 0.003151 **
## BPSysAve     0.0069601  0.0018049   3.856 0.000120 ***
## BPDiaAve     0.0094766  0.0024392   3.885 0.000107 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9865 on 1383 degrees of freedom
## Multiple R-squared:  0.121,  Adjusted R-squared:  0.1178
## F-statistic: 38.07 on 5 and 1383 DF,  p-value: < 2.2e-16
```

```r
reduced.model <- lm(pb.TotChol ~ Age + pb.Age2 + Height + BPSysAve + BPDiaAve,
                    data = p.BXCX.frame)
```

```
leverage <- hatvalues(reduced.model)
leverage
```

```
##           1           2           3           4           5           6
## 0.002671943 0.006339497 0.004877194 0.003448943 0.002127774 0.003820699
##           7           8           9          10          11          12
## 0.004694728 0.004694728 0.004694728 0.001524816 0.029913942 0.005097869
##          13          14          15          16          17          18
## 0.005097869 0.005097869 0.005097869 0.014971565 0.001425503 0.002120178
##          19          20          21          22          23          24
## 0.003856516 0.003856516 0.009153008 0.003914931 0.004631815 0.007426189
##          25          26          27          28          29          30
## 0.007426189 0.003307319 0.003307319 0.002408951 0.002408951 0.002846241
##          31          32          33          34          35          36
## 0.006138796 0.005381061 0.001799995 0.001799995 0.010666929 0.004404166
##          37          38          39          40          41          42
## 0.004404166 0.001391749 0.002747740 0.012431354 0.004081674 0.004471023
##          43          44          45          46          47          48
## 0.003031070 0.005819776 0.006286515 0.006286515 0.003422043 0.001555475
##          49          50          51          52          53          54
## 0.002187484 0.010323445 0.010323445 0.003567763 0.003676456 0.015723511
##          55          56          57          58          59          60
## 0.015723511 0.015723511 0.002260630 0.002800019 0.005405659 0.003355801
##          61          62          63          64          65          66
## 0.002051295 0.002930278 0.009432832 0.009432832 0.005026129 0.011266044
##          67          68          69          70          71          72
## 0.004303919 0.002589990 0.002352383 0.006677872 0.005394020 0.001877882
##          73          74          75          76          77          78
## 0.007797682 0.003260802 0.003260802 0.002665691 0.004590665 0.010902602
##          79          80          81          82          83          84
## 0.010902602 0.010852453 0.001945298 0.002873850 0.004634699 0.004634699
##          85          86          87          88          89          90
## 0.004444237 0.008237012 0.013055980 0.002613728 0.006752491 0.002293325
##          91          92          93          94          95          96
## 0.006157632 0.006157632 0.002305593 0.005193213 0.005193213 0.001639409
##          97          98          99         100         101         102
## 0.001639409 0.001639409 0.004672405 0.002235945 0.002235945 0.003449179
##         103         104         105         106         107         108
## 0.001291218 0.001291218 0.001291218 0.001291218 0.001291218 0.003080121
##         109         110         111         112         113         114
## 0.003996282 0.003996282 0.002216548 0.002216548 0.002721130 0.002296892
##         115         116         117         118         119         120
## 0.002296892 0.002296892 0.003295151 0.003295151 0.011476607 0.002023752
##         121         122         123         124         125         126
## 0.002023752 0.010374905 0.003860670 0.007041352 0.003375362 0.002210535
##         127         128         129         130         131         132
## 0.001582129 0.001780264 0.001780264 0.001805925 0.007383019 0.004176699
##         133         134         135         136         137         138
## 0.001852439 0.002827218 0.001766058 0.001766058 0.003161440 0.012597054
##         139         140         141         142         143         144
## 0.012597054 0.001377727 0.002276644 0.002276644 0.004400310 0.004400310
##         145         146         147         148         149         150
## 0.002648272 0.002405427 0.007611778 0.001663309 0.002325112 0.002049601
##         151         152         153         154         155         156
```

```
## 0.002049601 0.006946244 0.001410592 0.002062994 0.002265939 0.002265939
##         157         158         159         160         161         162
## 0.007114482 0.007114482 0.002643902 0.002643902 0.002643902 0.001680800
##         163         164         165         166         167         168
## 0.002205183 0.003287456 0.003580173 0.003580173 0.003739650 0.004022947
##         169         170         171         172         173         174
## 0.004022947 0.004618691 0.005162684 0.004075774 0.005392940 0.021132357
##         175         176         177         178         179         180
## 0.021132357 0.002055135 0.002060303 0.002060303 0.002060303 0.003335353
##         181         182         183         184         185         186
## 0.006948533 0.006948533 0.006948533 0.002128319 0.002128319 0.002128319
##         187         188         189         190         191         192
## 0.002614742 0.003879597 0.003641068 0.003641068 0.004429562 0.003354185
##         193         194         195         196         197         198
## 0.001395142 0.004827626 0.002270827 0.003723721 0.003723721 0.001284157
##         199         200         201         202         203         204
## 0.010462396 0.001941856 0.001514008 0.001514008 0.001514008 0.001514008
##         205         206         207         208         209         210
## 0.001899378 0.005253026 0.002523996 0.001300356 0.004781765 0.002769692
##         211         212         213         214         215         216
## 0.003960724 0.002779256 0.003375864 0.003375864 0.003375864 0.005796822
##         217         218         219         220         221         222
## 0.005796822 0.004275314 0.004275314 0.002019347 0.001619443 0.001619443
##         223         224         225         226         227         228
## 0.001619443 0.005237098 0.001488398 0.001488398 0.005736415 0.005736415
##         229         230         231         232         233         234
## 0.003900301 0.003624170 0.002184934 0.002184934 0.003187433 0.001930174
##         235         236         237         238         239         240
## 0.001930174 0.003103514 0.003103514 0.007802500 0.005902817 0.005902817
##         241         242         243         244         245         246
## 0.002304792 0.002304792 0.002304792 0.001723985 0.001723985 0.001952756
##         247         248         249         250         251         252
## 0.001952756 0.002627714 0.002627714 0.002627714 0.006648847 0.008963546
##         253         254         255         256         257         258
## 0.004473431 0.001870819 0.003210768 0.002469414 0.002469414 0.009445196
##         259         260         261         262         263         264
## 0.009445196 0.002415304 0.009664141 0.005323991 0.002132251 0.002041763
##         265         266         267         268         269         270
## 0.001957818 0.002625368 0.001795648 0.002473863 0.002473863 0.002473863
##         271         272         273         274         275         276
## 0.004367890 0.002376635 0.002057160 0.002057160 0.002483292 0.007047917
##         277         278         279         280         281         282
## 0.007047917 0.007047917 0.002705187 0.003166388 0.003166388 0.013473763
##         283         284         285         286         287         288
## 0.005038612 0.005038612 0.005038612 0.005038612 0.006366653 0.006819724
##         289         290         291         292         293         294
## 0.001688518 0.001688518 0.006736975 0.006377641 0.004737867 0.004595649
##         295         296         297         298         299         300
## 0.004595649 0.005395720 0.002067350 0.002067350 0.003488219 0.002123466
##         301         302         303         304         305         306
## 0.002123466 0.002123466 0.002497733 0.003512746 0.003512746 0.001881735
##         307         308         309         310         311         312
## 0.001881735 0.001675352 0.001675352 0.002826790 0.001835981 0.003496039
##         313         314         315         316         317         318
```

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## 0.004015489 0.002475298 0.004517491 0.004517491 0.003633296 0.005492487
##         319         320         321         322         323         324
## 0.004644131 0.005077593 0.003890522 0.008317793 0.004159763 0.002623708
##         325         326         327         328         329         330
## 0.001666881 0.002212592 0.009136630 0.006308937 0.002982426 0.004674546
##         331         332         333         334         335         336
## 0.004674546 0.002833472 0.003688922 0.008879536 0.001717016 0.001717016
##         337         338         339         340         341         342
## 0.002270145 0.002270145 0.004146406 0.001436818 0.004335391 0.004335391
##         343         344         345         346         347         348
## 0.002080537 0.002080537 0.002080537 0.003769638 0.003769638 0.003769638
##         349         350         351         352         353         354
## 0.002373812 0.002373812 0.005616483 0.005616483 0.005616483 0.003560854
##         355         356         357         358         359         360
## 0.004378976 0.004378976 0.002536320 0.003298548 0.003298548 0.003298548
##         361         362         363         364         365         366
## 0.006605174 0.003456207 0.003824615 0.002544321 0.002544321 0.002462005
##         367         368         369         370         371         372
## 0.002132505 0.001869369 0.001308691 0.004413719 0.004413719 0.004431598
##         373         374         375         376         377         378
## 0.004431598 0.001889096 0.010926925 0.001703686 0.004843937 0.007643638
##         379         380         381         382         383         384
## 0.002425884 0.004386855 0.004386855 0.002194742 0.004277013 0.001530269
##         385         386         387         388         389         390
## 0.004014101 0.004014101 0.001670820 0.001670820 0.005297903 0.002075194
##         391         392         393         394         395         396
## 0.012004599 0.003270142 0.002026550 0.002026550 0.002026550 0.003664599
##         397         398         399         400         401         402
## 0.004259563 0.003276261 0.006227680 0.006227680 0.006227680 0.007984646
##         403         404         405         406         407         408
## 0.007984646 0.003101730 0.003101730 0.002378087 0.002061433 0.002533095
##         409         410         411         412         413         414
## 0.002533095 0.029203449 0.003622969 0.003622969 0.002608331 0.003681658
##         415         416         417         418         419         420
## 0.006603452 0.006603452 0.006603452 0.002421730 0.004697580 0.004386940
##         421         422         423         424         425         426
## 0.003237726 0.002303435 0.002303435 0.009065973 0.009065973 0.009065973
##         427         428         429         430         431         432
## 0.009065973 0.013742573 0.013742573 0.004291746 0.003269781 0.003269781
##         433         434         435         436         437         438
## 0.003269781 0.003269781 0.007992374 0.007992374 0.006994302 0.001580355
##         439         440         441         442         443         444
## 0.001580355 0.001580355 0.002232993 0.002232993 0.002232993 0.002533067
##         445         446         447         448         449         450
## 0.002533067 0.003172288 0.007384383 0.004662580 0.001935460 0.002160056
##         451         452         453         454         455         456
## 0.002077286 0.002724801 0.002724801 0.002724801 0.002724801 0.002146705
##         457         458         459         460         461         462
## 0.002062446 0.007273784 0.007273784 0.002675242 0.001386660 0.001386660
##         463         464         465         466         467         468
## 0.001386660 0.001386660 0.007863662 0.001493887 0.002999160 0.002999160
##         469         470         471         472         473         474
## 0.002999160 0.002203029 0.002203029 0.002203029 0.002203029 0.005069985
##         475         476         477         478         479         480
```

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## 0.001878391 0.003146458 0.001611972 0.002791137 0.003088178 0.003088178
##         481         482         483         484         485         486
## 0.003838020 0.001926112 0.007780718 0.001966566 0.003288537 0.003375650
##         487         488         489         490         491         492
## 0.003375650 0.005622644 0.005622644 0.002255424 0.005227715 0.005227715
##         493         494         495         496         497         498
## 0.001810493 0.004788841 0.004788841 0.004788841 0.003766958 0.005996317
##         499         500         501         502         503         504
## 0.004235023 0.007772668 0.007772668 0.007772668 0.003154890 0.005760836
##         505         506         507         508         509         510
## 0.004062670 0.004062670 0.004062670 0.004062670 0.009156832 0.004335385
##         511         512         513         514         515         516
## 0.011202923 0.011202923 0.004330927 0.004330927 0.002054171 0.004329309
##         517         518         519         520         521         522
## 0.002888230 0.002888230 0.002888230 0.002574457 0.002574457 0.004561162
##         523         524         525         526         527         528
## 0.004561162 0.004561162 0.004561162 0.004561162 0.005661756 0.005661756
##         529         530         531         532         533         534
## 0.005661756 0.002161364 0.002180532 0.001844234 0.001844234 0.003804605
##         535         536         537         538         539         540
## 0.002980458 0.005043258 0.002911653 0.003380494 0.004705516 0.004005919
##         541         542         543         544         545         546
## 0.001797459 0.001797459 0.001797459 0.002397119 0.001583767 0.007172224
##         547         548         549         550         551         552
## 0.002931674 0.002759635 0.004237184 0.004237184 0.004237184 0.004237184
##         553         554         555         556         557         558
## 0.003630469 0.001477916 0.002037623 0.002755622 0.002755622 0.002755622
##         559         560         561         562         563         564
## 0.004900852 0.002312135 0.002312135 0.002312135 0.001665807 0.001665807
##         565         566         567         568         569         570
## 0.002408748 0.001704338 0.011280422 0.011280422 0.002063963 0.002063963
##         571         572         573         574         575         576
## 0.002063963 0.003776915 0.003776915 0.006638116 0.006638116 0.001449826
##         577         578         579         580         581         582
## 0.002022583 0.002022583 0.002022583 0.002022583 0.004507996 0.004507996
##         583         584         585         586         587         588
## 0.003416095 0.005410701 0.005410701 0.005410701 0.001913616 0.002055585
##         589         590         591         592         593         594
## 0.003127751 0.001912025 0.002630862 0.006563389 0.006563389 0.003668378
##         595         596         597         598         599         600
## 0.003668378 0.002127639 0.002127639 0.002238236 0.007076395 0.004763159
##         601         602         603         604         605         606
## 0.004763159 0.011277704 0.002128105 0.003061296 0.009177653 0.002298001
##         607         608         609         610         611         612
## 0.002298001 0.002090246 0.002090246 0.003958249 0.003958249 0.003958249
##         613         614         615         616         617         618
## 0.002803311 0.002803311 0.002803311 0.002803311 0.002882452 0.006577039
##         619         620         621         622         623         624
## 0.012939014 0.007883300 0.001871008 0.001871008 0.001871008 0.004990322
##         625         626         627         628         629         630
## 0.004990322 0.001801320 0.001754122 0.007333741 0.005256146 0.004526392
##         631         632         633         634         635         636
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##         637         638         639         640         641         642
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## 0.003896210 0.003896210 0.003896210 0.003367832 0.002328640 0.002482325
##         643         644         645         646         647         648
## 0.004271296 0.004271296 0.020187361 0.002636698 0.002021312 0.002858557
##         649         650         651         652         653         654
## 0.002858557 0.002858557 0.001973712 0.005145400 0.002295961 0.002295961
##         655         656         657         658         659         660
## 0.004244782 0.001992889 0.003157949 0.003157949 0.002956250 0.004157724
##         661         662         663         664         665         666
## 0.004713840 0.004713840 0.005010934 0.005952551 0.019912360 0.006742968
##         667         668         669         670         671         672
## 0.001559082 0.001559082 0.008781131 0.008781131 0.008781131 0.003029946
##         673         674         675         676         677         678
## 0.004706682 0.004706682 0.002793104 0.011704972 0.011704972 0.004404901
##         679         680         681         682         683         684
## 0.004404901 0.006606928 0.001890630 0.001381276 0.003987101 0.003276585
##         685         686         687         688         689         690
## 0.003276585 0.002025426 0.002025426 0.002025426 0.002025426 0.003601683
##         691         692         693         694         695         696
## 0.004484448 0.004484448 0.002858405 0.004333588 0.004333588 0.008707027
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## 0.005703413 0.005703413 0.003426638 0.003426638 0.001921935 0.001713143
##         703         704         705         706         707         708
## 0.002426603 0.002426603 0.002426603 0.002782530 0.002782530 0.002765592
##         709         710         711         712         713         714
## 0.002002036 0.004330047 0.004330047 0.002761191 0.002761191 0.003067514
##         715         716         717         718         719         720
## 0.002679269 0.012398348 0.012398348 0.001445673 0.002158597 0.004683168
##         721         722         723         724         725         726
## 0.003764614 0.003990795 0.003768996 0.003768996 0.009291976 0.009291976
##         727         728         729         730         731         732
## 0.005247481 0.004541342 0.010499486 0.003550931 0.003682130 0.002520944
##         733         734         735         736         737         738
## 0.002520944 0.008395370 0.008395370 0.006765333 0.006765333 0.007918836
##         739         740         741         742         743         744
## 0.001769056 0.001769056 0.003947608 0.003529692 0.002047542 0.008056558
##         745         746         747         748         749         750
## 0.026403327 0.026403327 0.001610473 0.003469621 0.009328151 0.003401178
##         751         752         753         754         755         756
## 0.002604583 0.002957141 0.002957141 0.003574551 0.001781940 0.008658494
##         757         758         759         760         761         762
## 0.001933989 0.004434736 0.003121192 0.002981939 0.002981939 0.011206533
##         763         764         765         766         767         768
## 0.002767390 0.006252507 0.003924678 0.003343166 0.003343166 0.002622657
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## 0.001565126 0.003830147 0.003402470 0.003402470 0.003402470 0.031506518
##         775         776         777         778         779         780
## 0.002276190 0.003869965 0.002708292 0.002099846 0.003775623 0.004924771
##         781         782         783         784         785         786
## 0.002357532 0.004122322 0.005147608 0.001235835 0.003235613 0.003235613
##         787         788         789         790         791         792
## 0.004323028 0.011281524 0.012324337 0.005194782 0.005194782 0.001546202
##         793         794         795         796         797         798
## 0.002613702 0.004867840 0.004718920 0.010894444 0.013536610 0.002477068
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```

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## 0.009678067 0.001988859 0.001988859 0.001988859 0.001988859 0.007398413
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## 0.007398413 0.010578887 0.003774650 0.003774650 0.008319535 0.009169937
##         811         812         813         814         815         816
## 0.004024523 0.002176131 0.002873261 0.005131563 0.001798583 0.001798583
##         817         818         819         820         821         822
## 0.001798583 0.005090084 0.013243260 0.003271704 0.007123127 0.001691786
##         823         824         825         826         827         828
## 0.003364872 0.003364872 0.003364872 0.002101940 0.001665809 0.002687958
##         829         830         831         832         833         834
## 0.002687958 0.002687958 0.003978105 0.002776690 0.003060519 0.002390730
##         835         836         837         838         839         840
## 0.001788847 0.001902546 0.001902546 0.004449540 0.004449540 0.004449540
##         841         842         843         844         845         846
## 0.002438700 0.002880661 0.001681663 0.008584098 0.008584098 0.006046694
##         847         848         849         850         851         852
## 0.006046694 0.003711272 0.001780654 0.001780654 0.002194641 0.004280993
##         853         854         855         856         857         858
## 0.004280993 0.005237226 0.002866519 0.002866519 0.004538489 0.010531549
##         859         860         861         862         863         864
## 0.001853516 0.001853516 0.001853516 0.001853516 0.001853516 0.001979874
##         865         866         867         868         869         870
## 0.002128781 0.002995249 0.001863620 0.002158696 0.003059530 0.003059530
##         871         872         873         874         875         876
## 0.001708509 0.001436448 0.002461073 0.003677606 0.002152433 0.002173930
##         877         878         879         880         881         882
## 0.003390621 0.003390621 0.004562000 0.004562000 0.004639821 0.003354503
##         883         884         885         886         887         888
## 0.003354503 0.003354503 0.002398175 0.002398175 0.002398175 0.006754725
##         889         890         891         892         893         894
## 0.006754725 0.002424438 0.008060000 0.009111801 0.002304128 0.002304128
##         895         896         897         898         899         900
## 0.002447606 0.001948301 0.005019162 0.008463305 0.008463305 0.004835744
##         901         902         903         904         905         906
## 0.004835744 0.010073262 0.002045649 0.002045649 0.008749910 0.002826982
##         907         908         909         910         911         912
## 0.002826982 0.002204152 0.003842101 0.004535015 0.008310845 0.008310845
##         913         914         915         916         917         918
## 0.002218152 0.003054824 0.003861571 0.004127434 0.004127434 0.002517240
##         919         920         921         922         923         924
## 0.006680769 0.004068210 0.003842118 0.011660897 0.006164436 0.016323841
##         925         926         927         928         929         930
## 0.016323841 0.004747254 0.005566605 0.001343405 0.001343405 0.009944095
##         931         932         933         934         935         936
## 0.009944095 0.006327555 0.006327555 0.008162744 0.001731166 0.001468398
##         937         938         939         940         941         942
## 0.002718220 0.001635900 0.002039316 0.002039316 0.001863435 0.005962353
##         943         944         945         946         947         948
## 0.003127349 0.002576323 0.002323164 0.004226643 0.002633158 0.002732498
##         949         950         951         952         953         954
## 0.002732498 0.007452658 0.004228358 0.001704132 0.002468720 0.002029967
##         955         956         957         958         959         960
## 0.002029967 0.002029967 0.003142350 0.003142350 0.002620860 0.004393062
##         961         962         963         964         965         966
```

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## 0.002439966 0.003542449 0.002252631 0.004214010 0.004844213 0.004844213
##         967         968         969         970         971         972
## 0.006771266 0.001722232 0.005648780 0.001835256 0.002199042 0.006330921
##         973         974         975         976         977         978
## 0.003575904 0.007357378 0.004466913 0.004035663 0.003060354 0.010900849
##         979         980         981         982         983         984
## 0.002213297 0.002213297 0.001526628 0.007825441 0.007825441 0.002827778
##         985         986         987         988         989         990
## 0.002881599 0.001701058 0.002650653 0.010335423 0.001569643 0.002642063
##         991         992         993         994         995         996
## 0.002433365 0.003844081 0.006521871 0.002856944 0.002856944 0.002856944
##         997         998         999        1000        1001        1002
## 0.002856944 0.011639132 0.010378091 0.002030515 0.002030515 0.002030515
##        1003        1004        1005        1006        1007        1008
## 0.004167577 0.004167577 0.004167577 0.002795082 0.005866100 0.002725222
##        1009        1010        1011        1012        1013        1014
## 0.002725222 0.006096199 0.001690468 0.001788385 0.001788385 0.003329770
##        1015        1016        1017        1018        1019        1020
## 0.002153301 0.002153301 0.002153301 0.002810325 0.002810325 0.001664284
##        1021        1022        1023        1024        1025        1026
## 0.007324970 0.003551437 0.003551437 0.001605464 0.006348204 0.003722708
##        1027        1028        1029        1030        1031        1032
## 0.003058811 0.002649916 0.006407378 0.001553290 0.004467204 0.002970548
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## 0.004938151 0.007097301 0.007097301 0.002080876 0.005590809 0.003474980
##        1039        1040        1041        1042        1043        1044
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## 0.005845285 0.001599404 0.004870752 0.002529842 0.002529842 0.002529842
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## 0.002529842 0.002225321 0.002225321 0.001660955 0.006949034 0.002533932
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## 0.003940456 0.002622311 0.003547591 0.003547591 0.003859493 0.002381942
##        1063        1064        1065        1066        1067        1068
## 0.004673561 0.002271071 0.002765632 0.007430748 0.007430748 0.001789396
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## 0.001520738 0.002378672 0.004503427 0.001722553 0.001722553 0.006471586
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## 0.009714728 0.001849726 0.003032671 0.004104385 0.004104385 0.003131300
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## 0.003131300 0.002391488 0.002132724 0.002132724 0.002132724 0.002129305
##        1093        1094        1095        1096        1097        1098
## 0.004873357 0.002908613 0.005047925 0.005047925 0.005047925 0.007334943
##        1099        1100        1101        1102        1103        1104
## 0.005296855 0.002752282 0.003603152 0.009969744 0.001835396 0.001835396
##        1105        1106        1107        1108        1109        1110
## 0.004683189 0.002222945 0.004264486 0.003491175 0.003430866 0.003430866
##        1111        1112        1113        1114        1115        1116
## 0.002684021 0.001599822 0.005630399 0.002366728 0.002366728 0.006680346
##        1117        1118        1119        1120        1121        1122
## 0.002179175 0.001767947 0.002013080 0.002425381 0.003143861 0.003143861
##        1123        1124        1125        1126        1127        1128
```

```
## 0.010103600 0.010103600 0.010103600 0.002826623 0.002606623 0.009654544
##       1129       1130       1131       1132       1133       1134
## 0.001905400 0.007728583 0.001940318 0.003082940 0.003082940 0.003082940
##       1135       1136       1137       1138       1139       1140
## 0.001863174 0.004975605 0.004975605 0.017900387 0.017900387 0.017900387
##       1141       1142       1143       1144       1145       1146
## 0.017900387 0.003055060 0.002178681 0.007385897 0.007385897 0.006069703
##       1147       1148       1149       1150       1151       1152
## 0.007709100 0.007709100 0.007709100 0.001919890 0.001919890 0.003749367
##       1153       1154       1155       1156       1157       1158
## 0.001791234 0.004131747 0.004947369 0.004947369 0.003409032 0.003414411
##       1159       1160       1161       1162       1163       1164
## 0.002104480 0.002104480 0.003231284 0.003861015 0.006047224 0.003171323
##       1165       1166       1167       1168       1169       1170
## 0.001716748 0.001716748 0.001716748 0.001716748 0.001718320 0.001718320
##       1171       1172       1173       1174       1175       1176
## 0.002704145 0.006381646 0.006381646 0.005787389 0.005787389 0.007938027
##       1177       1178       1179       1180       1181       1182
## 0.005314202 0.003362448 0.002376299 0.002165672 0.002165672 0.002248695
##       1183       1184       1185       1186       1187       1188
## 0.002912624 0.002347629 0.002347629 0.010975626 0.008659877 0.008659877
##       1189       1190       1191       1192       1193       1194
## 0.001596761 0.004351957 0.004898249 0.003137272 0.003137272 0.007924990
##       1195       1196       1197       1198       1199       1200
## 0.001343536 0.001550488 0.001550488 0.001706096 0.003752362 0.006230383
##       1201       1202       1203       1204       1205       1206
## 0.004103272 0.006111893 0.008380693 0.008380693 0.008385779 0.003781628
##       1207       1208       1209       1210       1211       1212
## 0.004055366 0.003983851 0.002647276 0.002932118 0.003808541 0.004590103
##       1213       1214       1215       1216       1217       1218
## 0.002610277 0.001190540 0.005709665 0.005253835 0.005253835 0.005253835
##       1219       1220       1221       1222       1223       1224
## 0.002074788 0.002074788 0.001880527 0.018360170 0.003429079 0.004263231
##       1225       1226       1227       1228       1229       1230
## 0.004263231 0.003288588 0.001893073 0.002409164 0.009887529 0.002104820
##       1231       1232       1233       1234       1235       1236
## 0.007295705 0.001850032 0.001813846 0.008751537 0.005217900 0.008115081
##       1237       1238       1239       1240       1241       1242
## 0.011584852 0.002597019 0.001883802 0.001883802 0.005040906 0.005040906
##       1243       1244       1245       1246       1247       1248
## 0.009015705 0.009015705 0.009015705 0.002801229 0.003573356 0.005027656
##       1249       1250       1251       1252       1253       1254
## 0.005027656 0.001814728 0.003084360 0.003084360 0.003084360 0.003084360
##       1255       1256       1257       1258       1259       1260
## 0.011355929 0.011355929 0.011355929 0.002205705 0.011734094 0.006803343
##       1261       1262       1263       1264       1265       1266
## 0.006803343 0.001981198 0.001981198 0.004452512 0.003928807 0.003160626
##       1267       1268       1269       1270       1271       1272
## 0.003898771 0.010909614 0.001902279 0.004018447 0.006782052 0.001750032
##       1273       1274       1275       1276       1277       1278
## 0.001791200 0.001791200 0.001791200 0.003357004 0.001838187 0.003734573
##       1279       1280       1281       1282       1283       1284
## 0.001594349 0.001594349 0.001594349 0.003547242 0.003934682 0.010836636
##       1285       1286       1287       1288       1289       1290
```

```
## 0.001891710 0.002742249 0.002742249 0.036432102 0.003735780 0.003735780
##         1291         1292         1293         1294         1295         1296
## 0.002487576 0.006219101 0.006219101 0.006473026 0.003809589 0.014443854
##         1297         1298         1299         1300         1301         1302
## 0.004146301 0.004146301 0.001936461 0.005547053 0.005547053 0.003781521
##         1303         1304         1305         1306         1307         1308
## 0.003781521 0.002646706 0.002646706 0.007738667 0.002889370 0.002889370
##         1309         1310         1311         1312         1313         1314
## 0.002889370 0.004773643 0.002923221 0.003256552 0.001935411 0.002662167
##         1315         1316         1317         1318         1319         1320
## 0.002662167 0.002662167 0.002163734 0.009381342 0.001490566 0.003139303
##         1321         1322         1323         1324         1325         1326
## 0.003139303 0.006050041 0.006050041 0.006050041 0.002535983 0.005459139
##         1327         1328         1329         1330         1331         1332
## 0.004542308 0.002697919 0.002697919 0.002697919 0.001703375 0.001703375
##         1333         1334         1335         1336         1337         1338
## 0.001703375 0.002196090 0.004583587 0.006137828 0.004007781 0.004007781
##         1339         1340         1341         1342         1343         1344
## 0.004007781 0.001686397 0.003667485 0.003667485 0.005057859 0.005057859
##         1345         1346         1347         1348         1349         1350
## 0.005057859 0.001730364 0.003436579 0.004136093 0.004509229 0.008691985
##         1351         1352         1353         1354         1355         1356
## 0.001903103 0.001903103 0.005817588 0.003429838 0.006038002 0.006038002
##         1357         1358         1359         1360         1361         1362
## 0.003657694 0.002885625 0.001799184 0.001799184 0.002140552 0.001862341
##         1363         1364         1365         1366         1367         1368
## 0.001947286 0.003284975 0.002233327 0.002233327 0.003032682 0.010390769
##         1369         1370         1371         1372         1373         1374
## 0.003562990 0.003562990 0.002796092 0.010565383 0.004423538 0.007335207
##         1375         1376         1377         1378         1379         1380
## 0.005000978 0.001901382 0.003728341 0.003286205 0.003812498 0.004306585
##         1381         1382         1383         1384         1385         1386
## 0.004306585 0.004955764 0.007381407 0.001983914 0.002184874 0.002184874
##         1387         1388         1389
## 0.001515872 0.001515872 0.004032416
```

```r
## Threshold
p <- 5
high_lev <- 2*(p+1)/n
high_lev
```

```
## [1] 0.008639309
```

```r
## Find the leverage points
leverage_points_index <- which(leverage > high_lev)
leverage_points_index
```

```
##    11    16    21    35    40    50    51    54    55    56    63    64    66    78    79    80
##    11    16    21    35    40    50    51    54    55    56    63    64    66    78    79    80
##    87   119   122   138   139   174   175   199   252   258   259   261   282   327   334   375
##    87   119   122   138   139   174   175   199   252   258   259   261   282   327   334   375
##   391   410   424   425   426   427   428   429   509   511   512   567   568   602   605   619
##   391   410   424   425   426   427   428   429   509   511   512   567   568   602   605   619
##   634   645   665   669   670   671   676   677   696   716   717   725   726   729   745   746
##   634   645   665   669   670   671   676   677   696   716   717   725   726   729   745   746
```

```
## 749  756  762  774  788  789  796  797  799  806  810  819  858  892  902  905
## 749  756  762  774  788  789  796  797  799  806  810  819  858  892  902  905
## 922  924  925  930  931  978  988  998  999 1074 1081 1102 1123 1124 1125 1128
## 922  924  925  930  931  978  988  998  999 1074 1081 1102 1123 1124 1125 1128
## 1138 1139 1140 1141 1186 1187 1188 1222 1229 1234 1237 1243 1244 1245 1255 1256
## 1138 1139 1140 1141 1186 1187 1188 1222 1229 1234 1237 1243 1244 1245 1255 1256
## 1257 1259 1268 1284 1288 1296 1318 1350 1368 1372
## 1257 1259 1268 1284 1288 1296 1318 1350 1368 1372
```

```r
rownames(p.BXCX.frame)[leverage_points_index]
```

```
##   [1] "11"   "16"   "21"   "35"   "40"   "50"   "51"   "54"   "55"   "56"
##  [11] "63"   "64"   "66"   "78"   "79"   "80"   "87"   "119"  "122"  "138"
##  [21] "139"  "174"  "175"  "199"  "252"  "258"  "259"  "261"  "282"  "327"
##  [31] "334"  "375"  "391"  "410"  "424"  "425"  "426"  "427"  "428"  "429"
##  [41] "509"  "511"  "512"  "567"  "568"  "602"  "605"  "619"  "634"  "645"
##  [51] "665"  "669"  "670"  "671"  "676"  "677"  "696"  "716"  "717"  "725"
##  [61] "726"  "729"  "745"  "746"  "749"  "756"  "762"  "774"  "788"  "789"
##  [71] "796"  "797"  "799"  "806"  "810"  "819"  "858"  "892"  "902"  "905"
##  [81] "922"  "924"  "925"  "930"  "931"  "978"  "988"  "998"  "999"  "1074"
##  [91] "1081" "1102" "1123" "1124" "1125" "1128" "1138" "1139" "1140" "1141"
## [101] "1186" "1187" "1188" "1222" "1229" "1234" "1237" "1243" "1244" "1245"
## [111] "1255" "1256" "1257" "1259" "1268" "1284" "1288" "1296" "1318" "1350"
## [121] "1368" "1372"
```

```r
## Check if the absolute values of the standardized residuals are greater than 3
st.residuals <- rstandard(reduced.model) ## standardized residuals
st.residuals
```

```
##             1             2             3             4             5
##  0.0815642409 -0.7747609115 -0.4642375161 -0.4323281708 -0.8123308965
##             6             7             8             9            10
##  0.9311364122 -0.2085452517 -0.2085452517 -0.2085452517 -0.8576300018
##            11            12            13            14            15
##  1.6373335616 -0.9001984073 -0.9001984073 -0.9001984073 -0.9001984073
##            16            17            18            19            20
## -0.8623953410 -1.2969996397  0.5487332607 -0.2415397897 -0.2415397897
##            21            22            23            24            25
##  0.5512238914  0.6075860997 -1.0387571358  0.5940529975  0.5940529975
##            26            27            28            29            30
##  1.0742147615  1.0742147615  0.3060985183  0.3060985183 -0.3512677374
##            31            32            33            34            35
##  0.8893833369  0.8584892483  2.0048495136  2.0048495136 -0.8302409398
##            36            37            38            39            40
## -1.3347443796 -1.3347443796 -0.9265607927 -0.5311540645  0.7872041704
##            41            42            43            44            45
## -0.0463196509  0.4074137805  2.0020859382 -2.3876399657  1.0405460723
##            46            47            48            49            50
##  1.0405460723  0.6083377999  2.1167497888 -0.0340170363 -0.5209013153
##            51            52            53            54            55
## -0.5209013153  2.0642290375  0.7452443763 -1.1409248192 -1.1409248192
##            56            57            58            59            60
## -1.1409248192  0.6083328865  0.0777752022  0.2309974735  0.7493153666
##            61            62            63            64            65
## -1.4504764681  0.1524729963 -0.3857451741 -0.3857451741 -0.2977439080
##            66            67            68            69            70
```

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```
##  0.2231662197 -0.7173898172 -1.4624071090  0.3769076286  1.1774909573
##           71           72           73           74           75
## -0.1830274667  0.2165157380 -1.1924307879 -1.1601982043 -1.1601982043
##           76           77           78           79           80
## -0.5826265714 -0.4893352489  0.7465379828  0.7465379828  0.2716955874
##           81           82           83           84           85
## -0.0832397179 -0.4129574704 -0.5760419038 -0.5760419038 -0.5435036565
##           86           87           88           89           90
##  0.6745427321 -0.0125127409 -1.4099384998  0.1372412024  0.9383713558
##           91           92           93           94           95
##  1.0386793737  1.0386793737 -0.6860451192  0.5737634785  0.5737634785
##           96           97           98           99          100
## -0.1742286558 -0.1742286558 -0.1742286558  0.6230056730 -0.3908183023
##          101          102          103          104          105
## -0.3908183023  1.6989799409 -0.4189987042 -0.4189987042 -0.4189987042
##          106          107          108          109          110
## -0.4189987042 -0.4189987042  0.4289130249  0.4759855779  0.4759855779
##          111          112          113          114          115
##  2.0483928290  2.0483928290 -0.3365872178  0.5625165070  0.5625165070
##          116          117          118          119          120
##  0.5625165070  2.1857333792  2.1857333792  0.0124038606  0.2785298788
##          121          122          123          124          125
##  0.2785298788  1.7042612823 -0.4567446967 -0.0951454979 -0.4415565263
##          126          127          128          129          130
## -0.0122619278  1.9112208815 -0.5036012042 -0.5036012042 -0.4115801490
##          131          132          133          134          135
## -0.0247571748 -1.2294579147  0.0376407204  0.2217250323  0.3939664337
##          136          137          138          139          140
##  0.3939664337  1.1698500078 -1.2748402391 -1.2748402391  0.1735558857
##          141          142          143          144          145
## -0.3943917445 -0.3943917445 -1.2804812842 -1.2804812842  0.8872294781
##          146          147          148          149          150
##  0.9530661015 -0.1797351331 -1.2823382504 -1.8553790313  0.4155534126
##          151          152          153          154          155
##  0.4155534126 -0.5552653157  0.0595002418 -0.0420837172 -0.9387200512
##          156          157          158          159          160
## -0.9387200512 -1.4550318096 -1.4550318096 -1.2925278247 -1.2925278247
##          161          162          163          164          165
## -1.2925278247 -0.6275990107  0.2300456816  0.5113852442 -0.1196569105
##          166          167          168          169          170
## -0.1196569105 -1.1591706240  0.2851350603  0.2851350603  1.6823060860
##          171          172          173          174          175
##  0.4615666567 -0.0171607707  1.0616402614  1.6983144523  1.6983144523
##          176          177          178          179          180
## -1.2892649328 -0.8340874924 -0.8340874924 -0.8340874924  0.3268314711
##          181          182          183          184          185
##  0.4753149481  0.4753149481  0.4753149481  0.3513212176  0.3513212176
##          186          187          188          189          190
##  0.3513212176 -0.5822507059 -1.2769077291  0.1838418993  0.1838418993
##          191          192          193          194          195
##  3.0247380288  0.3525663143  0.4541809320  0.8481401221  0.8613588520
##          196          197          198          199          200
## -0.3019182386 -0.3019182386  0.0869292581 -0.9341631646  2.4962124145
##          201          202          203          204          205
```

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```
##  1.2855430176  1.2855430176  1.2855430176  1.2855430176 -1.2405212612
##           206           207           208           209           210
## -1.4738179492 -1.1644772039 -0.4717540965  0.7339954816  1.4012395170
##           211           212           213           214           215
## -0.4631288733 -0.7953095098  1.4333465254  1.4333465254  1.4333465254
##           216           217           218           219           220
##  1.1326967981  1.1326967981  1.5398921275  1.5398921275  2.0255528908
##           221           222           223           224           225
## -0.3262225892 -0.3262225892 -0.3262225892 -0.9021729668  0.8950105556
##           226           227           228           229           230
##  0.8950105556  0.3632953369  0.3632953369  0.6940417914  0.5417207657
##           231           232           233           234           235
## -0.1986274514 -0.1986274514  2.0073235580 -0.7463047736 -0.7463047736
##           236           237           238           239           240
##  1.0572064160  1.0572064160 -0.0620405942  0.6780624623  0.6780624623
##           241           242           243           244           245
## -1.0336089674 -1.0336089674 -1.0336089674  0.0396430935  0.0396430935
##           246           247           248           249           250
##  0.3404618001  0.3404618001 -0.8382842771 -0.8382842771 -0.8382842771
##           251           252           253           254           255
## -0.4208578287  0.8929660518  1.5828676029 -0.3173098893  1.4369194535
##           256           257           258           259           260
##  1.1359235575  1.1359235575 -0.1208986038 -0.1208986038 -0.8287967113
##           261           262           263           264           265
## -0.0058132031 -0.4360560422  0.0546431136  1.6547658183 -0.4597939803
##           266           267           268           269           270
##  0.3131137218  0.2138350727  0.3285929968  0.3285929968  0.3285929968
##           271           272           273           274           275
##  0.2600088791 -0.4011326391  0.3569996972  0.3569996972 -0.4840958514
##           276           277           278           279           280
## -0.6430620045 -0.6430620045 -0.6430620045 -0.2576646668  0.3116274411
##           281           282           283           284           285
##  0.3116274411 -0.5655164184 -1.4879742948 -1.4879742948 -1.4879742948
##           286           287           288           289           290
## -1.4879742948 -0.2035382387  0.5239811062 -0.0389994744 -0.0389994744
##           291           292           293           294           295
## -0.0212398361 -0.7008942860  2.1255475086 -0.7402342408 -0.7402342408
##           296           297           298           299           300
## -0.0031122406 -0.3310322581 -0.3310322581  0.1783107991 -0.6476528100
##           301           302           303           304           305
## -0.6476528100 -0.6476528100 -0.6676915312 -1.2241439231 -1.2241439231
##           306           307           308           309           310
## -0.3879718974 -0.3879718974  0.1025565156  0.1025565156  0.5654617898
##           311           312           313           314           315
##  1.3755285935 -1.4911882772  0.1263321018  0.7107328540 -1.4403912499
##           316           317           318           319           320
## -1.4403912499  2.0686891659 -0.7720500352  0.7027918989 -0.0241574663
##           321           322           323           324           325
## -0.9747710113 -0.1245195347  1.1678506693 -0.1534370298 -0.3990154832
##           326           327           328           329           330
## -0.1163491588  0.1418118938  0.7262909975  0.0574790764  0.0444531925
##           331           332           333           334           335
##  0.0444531925  0.1602195238 -0.2783952048  0.1183992657 -0.3900205660
##           336           337           338           339           340
```

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```
## -0.3900205660 -1.3469047122 -1.3469047122 -0.4815443364  0.7271399211
##            341            342            343            344            345
## -1.0412711667 -1.0412711667  0.3987392735  0.3987392735  0.3987392735
##            346            347            348            349            350
##  0.6987557008  0.6987557008  0.6987557008 -1.3436970212 -1.3436970212
##            351            352            353            354            355
##  0.0191058466  0.0191058466  0.0191058466  1.1255306599  0.6355974629
##            356            357            358            359            360
##  0.6355974629 -1.3647350111  0.0075279402  0.0075279402  0.0075279402
##            361            362            363            364            365
##  0.5844064310  0.2437586039 -1.3041259751 -0.2006461335 -0.2006461335
##            366            367            368            369            370
## -0.0804694433  0.2479677219 -1.1170500000  0.2628627725  1.9211442769
##            371            372            373            374            375
##  1.9211442769  0.7817971888  0.7817971888  0.5075192691 -1.0779298374
##            376            377            378            379            380
## -1.6298457284  1.4428850773  0.9208814059  0.0075463093  0.7667832144
##            381            382            383            384            385
##  0.7667832144  2.8856345851 -0.5795319669  0.3137466525  1.1347340638
##            386            387            388            389            390
##  1.1347340638  0.2657951603  0.2657951603 -2.0730735194 -0.5375367167
##            391            392            393            394            395
##  0.7450922544  2.3050177290 -0.7787576821 -0.7787576821 -0.7787576821
##            396            397            398            399            400
##  0.4488689529  0.2521008423 -0.4005310383  1.8328256424  1.8328256424
##            401            402            403            404            405
##  1.8328256424  0.9359302773  0.9359302773  0.7988160871  0.7988160871
##            406            407            408            409            410
##  0.5400164008  0.7836113260 -1.3291540174 -1.3291540174  1.8511868122
##            411            412            413            414            415
##  1.2569062948  1.2569062948 -0.3555863976 -0.7235904945  0.5525706659
##            416            417            418            419            420
##  0.5525706659  0.5525706659 -0.3112412527  0.3321080608  0.0337685453
##            421            422            423            424            425
##  0.7004308417  0.4058928887  0.4058928887  0.1172231957  0.1172231957
##            426            427            428            429            430
##  0.1172231957  0.1172231957  0.1866278440  0.1866278440 -0.3378622889
##            431            432            433            434            435
##  0.5851980733  0.5851980733  0.5851980733  0.5851980733  0.8108620472
##            436            437            438            439            440
##  0.8108620472 -0.1928221366  1.7709423794  1.7709423794  1.7709423794
##            441            442            443            444            445
##  0.1644250484  0.1644250484  0.1644250484  0.5065755972  0.5065755972
##            446            447            448            449            450
##  1.2101265235  0.9399324512  1.4849852711 -0.2786853847 -0.9199825040
##            451            452            453            454            455
##  0.2055771741  0.1659850090  0.1659850090  0.1659850090  0.1659850090
##            456            457            458            459            460
## -0.0180148023  0.6867290999 -1.2943959960 -1.2943959960  0.9384914579
##            461            462            463            464            465
##  2.7779290160  2.7779290160  2.7779290160  2.7779290160  1.2008301109
##            466            467            468            469            470
## -0.6880069535  1.5620373734  1.5620373734  1.5620373734 -0.9232666921
##            471            472            473            474            475
```

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## -0.9232666921 -0.9232666921 -0.9232666921  1.3142363490  0.7964791847
##           476           477           478           479           480
## -3.1829876905  1.4284341662  1.0970508081  0.9667668606  0.9667668606
##           481           482           483           484           485
## -0.1232000021 -1.6063499057  2.0134744457 -1.4832293945 -1.1976407623
##           486           487           488           489           490
##  0.1900705414  0.1900705414 -0.2495147253 -0.2495147253 -0.3720502320
##           491           492           493           494           495
## -0.0467036191 -0.0467036191  1.2482734185  1.6836418277  1.6836418277
##           496           497           498           499           500
##  1.6836418277 -1.2460493101  1.4896176631 -1.2308474262  0.2736428598
##           501           502           503           504           505
##  0.2736428598  0.2736428598  0.4524068593 -0.4754395853  0.0936152698
##           506           507           508           509           510
##  0.0936152698  0.0936152698  0.0936152698 -0.7798154620  0.7896387323
##           511           512           513           514           515
##  1.0247437535  1.0247437535  0.6559577472  0.6559577472 -0.1062862148
##           516           517           518           519           520
##  0.1077590582 -0.7584326768 -0.7584326768 -0.7584326768 -0.1527352046
##           521           522           523           524           525
## -0.1527352046 -0.5396940340 -0.5396940340 -0.5396940340 -0.5396940340
##           526           527           528           529           530
## -0.5396940340  0.3686954335  0.3686954335  0.3686954335  0.5794119437
##           531           532           533           534           535
## -0.2543111270  0.0385066086  0.0385066086 -0.3876216178  0.7002399770
##           536           537           538           539           540
## -0.6287288746  0.9659953474  0.3403948713 -0.8793542218  0.1746191296
##           541           542           543           544           545
##  0.8563914180  0.8563914180  0.8563914180 -1.2344377361 -0.2192934783
##           546           547           548           549           550
## -0.0361551254  0.1392853506 -0.1061919244 -0.0542080997 -0.0542080997
##           551           552           553           554           555
## -0.0542080997 -0.0542080997  1.0208694843  1.2908961235  1.9309783197
##           556           557           558           559           560
## -0.1043490565 -0.1043490565 -0.1043490565  0.5016948588 -1.0583375579
##           561           562           563           564           565
## -1.0583375579 -1.0583375579 -0.0014321926 -0.0014321926  1.6004588156
##           566           567           568           569           570
## -0.4434666574 -0.4963768981 -0.4963768981 -0.9596780293 -0.9596780293
##           571           572           573           574           575
## -0.9596780293  0.7734314059  0.7734314059 -0.5752539617 -0.5752539617
##           576           577           578           579           580
## -1.1082155553  0.5762946528  0.5762946528  0.5762946528  0.5762946528
##           581           582           583           584           585
##  1.7772896303  1.7772896303  0.1152717086  0.8769240961  0.8769240961
##           586           587           588           589           590
##  0.8769240961  0.6909111568  0.5209835337  2.3579764035 -1.1780587010
##           591           592           593           594           595
## -0.1881614925 -1.9233997779 -1.9233997779 -0.5120867408 -0.5120867408
##           596           597           598           599           600
## -1.0688573468 -1.0688573468 -0.6337054421 -0.7710692675 -0.1093842227
##           601           602           603           604           605
## -0.1093842227  1.6008464584 -0.5283197845  0.1876785970  1.2404938579
##           606           607           608           609           610
```

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##   0.2931532288   0.2931532288   0.3032360628   0.3032360628   0.7732421076
##            611            612            613            614            615
##   0.7732421076   0.7732421076   0.9527559201   0.9527559201   0.9527559201
##            616            617            618            619            620
##   0.9527559201   1.9978623607  -1.4361776843  -0.2089061520  -1.9175217703
##            621            622            623            624            625
##   1.2001046003   1.2001046003   1.2001046003  -0.4780451791  -0.4780451791
##            626            627            628            629            630
## -1.5973207102   0.4138834706  -0.8453080542   0.1694541043   0.0343015883
##            631            632            633            634            635
##   0.0343015883   0.4877720619   0.4882496009   0.8471317340  -0.2698288405
##            636            637            638            639            640
##   2.5753226757   0.6298381074   0.6298381074   0.6298381074   0.4885335285
##            641            642            643            644            645
## -0.9010043590   0.3242347248  -0.8610691099  -0.8610691099  -0.2771836891
##            646            647            648            649            650
##   0.2995735140   1.2128969006  -1.2414727441  -1.2414727441  -1.2414727441
##            651            652            653            654            655
## -1.6546876778  -0.8772890780   0.2040457990   0.2040457990  -1.6669836174
##            656            657            658            659            660
##   1.2557485643  -0.1121224982  -0.1121224982   1.3458056997   0.5703314862
##            661            662            663            664            665
##   0.0704740433   0.0704740433  -1.9759817007   0.7001919129   0.9109150183
##            666            667            668            669            670
## -0.7990501106  -0.4022503009  -0.4022503009   0.6884476271   0.6884476271
##            671            672            673            674            675
##   0.6884476271   1.2329273164   0.4740756166   0.4740756166  -0.3939744400
##            676            677            678            679            680
##   1.2281791772   1.2281791772   1.1741476672   1.1741476672   0.6381764124
##            681            682            683            684            685
## -0.3669120091   0.6431764127  -0.4269777193  -0.9134710638  -0.9134710638
##            686            687            688            689            690
##   0.1221586673   0.1221586673   0.1221586673   0.1221586673   0.6782181534
##            691            692            693            694            695
## -1.6039683790  -1.6039683790  -0.7338692014   0.3301505740   0.3301505740
##            696            697            698            699            700
## -1.4458277109  -0.3413698450  -0.3413698450  -1.0495775408  -1.0495775408
##            701            702            703            704            705
## -0.5753749492  -1.7700158569  -0.3338049871  -0.3338049871  -0.3338049871
##            706            707            708            709            710
##   1.5493924652   1.5493924652   0.5722627799  -0.6787882906  -0.5520487595
##            711            712            713            714            715
## -0.5520487595  -0.2867364794  -0.2867364794  -1.7118960357   1.6921398707
##            716            717            718            719            720
## -1.0809535884  -1.0809535884   0.3645884587  -0.6895281550   0.4152405280
##            721            722            723            724            725
##   0.5732064020   1.3425509936  -1.6755222244  -1.6755222244  -0.3162093009
##            726            727            728            729            730
## -0.3162093009  -1.7127572527  -0.5277222911  -0.3136249380  -0.5980245069
##            731            732            733            734            735
##   0.9533792215  -0.3136263897  -0.3136263897  -0.8590821708  -0.8590821708
##            736            737            738            739            740
## -1.7706840015  -1.7706840015  -1.1422560798  -1.7928632163  -1.7928632163
##            741            742            743            744            745
```

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##   1.1284879418   2.1366882865  -0.6755487418  -1.2710911977   0.2612203638
##            746            747            748            749            750
##   0.2612203638   0.4469236306   1.2209750502   0.9934712705  -0.2967905935
##            751            752            753            754            755
##  -0.2156008379  -0.5490684017  -0.5490684017  -1.6523010467  -2.3178268330
##            756            757            758            759            760
##   0.5246409477  -0.1678448432  -0.0225531107  -0.0691693635  -0.8899280949
##            761            762            763            764            765
##  -0.8899280949  -1.7372228255  -0.7634391440  -1.2371894268   0.5661619998
##            766            767            768            769            770
##  -0.1559040277  -0.1559040277  -0.0856406534   0.2733413340  -1.9578637211
##            771            772            773            774            775
##  -1.0019161110  -1.0019161110  -1.0019161110   2.7303175866  -0.3116109026
##            776            777            778            779            780
##  -0.2444406364  -0.2602346193  -0.7061236178   0.3822472775   0.0864817837
##            781            782            783            784            785
##  -1.7385208607  -1.4393237303   1.1398704924   0.7984827990   1.3643663147
##            786            787            788            789            790
##   1.3643663147  -3.2778952433  -1.2591997673  -0.5536230226   1.8112175903
##            791            792            793            794            795
##   1.8112175903  -0.5201538539  -1.1556317407   0.0740573725   0.6572602623
##            796            797            798            799            800
##   0.6292210609  -0.1234351568  -1.3134308367  -0.3739214084  -0.4721218250
##            801            802            803            804            805
##  -0.4721218250  -0.4721218250  -0.4721218250  -0.4507841613  -0.4507841613
##            806            807            808            809            810
##  -1.3219211773   0.5996018602   0.5996018602  -2.4540013909  -0.0723082161
##            811            812            813            814            815
##  -0.9239930271   0.6318081771   0.4709052666  -0.6067831435  -2.0267678452
##            816            817            818            819            820
##  -2.0267678452  -2.0267678452   1.5644129341  -0.6641146681   1.1209330278
##            821            822            823            824            825
##  -0.0860597782   0.2472489151  -0.7732992081  -0.7732992081  -0.7732992081
##            826            827            828            829            830
##   0.4388600401  -0.2576336786   1.0876838232   1.0876838232   1.0876838232
##            831            832            833            834            835
##  -0.9497962269   1.4720411566   0.0912764525  -0.7279210731   1.4215050213
##            836            837            838            839            840
##   0.0651523050   0.0651523050  -0.6248510150  -0.6248510150  -0.6248510150
##            841            842            843            844            845
##  -0.7198386285  -1.2004091882   0.6884002607   0.7923183845   0.7923183845
##            846            847            848            849            850
##   1.0726557889   1.0726557889   1.2830261179  -0.4454861045  -0.4454861045
##            851            852            853            854            855
##  -0.0695022069  -0.4479518671  -0.4479518671   1.0429739280   0.5448239238
##            856            857            858            859            860
##   0.5448239238   0.9763746489   1.2930199288   0.7540646649   0.7540646649
##            861            862            863            864            865
##   0.7540646649   0.7540646649   0.7540646649  -0.3419341388  -2.3207728545
##            866            867            868            869            870
##  -2.7330435936  -1.0193681216   1.0701380864   1.0382983068   1.0382983068
##            871            872            873            874            875
##   0.3280274212  -0.2130097698   0.8755642172   0.3807295362  -0.1604682539
##            876            877            878            879            880
```

```
## -0.0339462817  0.6624141584  0.6624141584  3.2618383635  3.2618383635
##           881           882           883           884           885
##  0.0681379294  0.8116289017  0.8116289017  0.8116289017 -1.5656895062
##           886           887           888           889           890
## -1.5656895062 -1.5656895062 -2.5974438701 -2.5974438701  3.8995486746
##           891           892           893           894           895
## -1.8847568038 -0.9977498483  0.5010356933  0.5010356933 -0.2789215922
##           896           897           898           899           900
##  0.6955263930 -1.4459080587  1.0403404601  1.0403404601 -0.4681814345
##           901           902           903           904           905
## -0.4681814345  1.3649621482  0.7406532101  0.7406532101  1.9048006559
##           906           907           908           909           910
##  0.5595557298  0.5595557298  1.4200140916  0.3111781802  0.2532324648
##           911           912           913           914           915
## -1.5670975670 -1.5670975670  0.3769704737 -1.2438566644 -1.2199866893
##           916           917           918           919           920
## -0.5144928479 -0.5144928479 -1.6191700076  0.4759814412  0.7223980115
##           921           922           923           924           925
##  0.3866903231  0.3375825142 -0.1527270507 -0.9798448077 -0.9798448077
##           926           927           928           929           930
## -1.1835459245  1.2356554153 -1.9546409062 -1.9546409062 -0.2786673053
##           931           932           933           934           935
## -0.2786673053 -0.1971834736 -0.1971834736 -1.3896915682 -0.5381767856
##           936           937           938           939           940
##  1.6666505449 -2.2100579675 -0.5062281490  0.0497333819  0.0497333819
##           941           942           943           944           945
## -0.4428498115  0.9922424031 -1.3704472751  0.8059515323  1.0263763695
##           946           947           948           949           950
##  0.6852342783  1.6165050988 -0.9384005802 -0.9384005802  0.1180422230
##           951           952           953           954           955
## -0.0492730359  0.3844972714 -0.6544610420 -0.2906571510 -0.2906571510
##           956           957           958           959           960
## -0.2906571510 -0.1418491787 -0.1418491787 -0.7112103487 -2.1708493487
##           961           962           963           964           965
##  0.7118067107  0.8376195146  0.1901655486 -0.3539681710 -1.9550280105
##           966           967           968           969           970
## -1.9550280105  0.5041631314 -3.0099128654  1.0526446263  1.2718386870
##           971           972           973           974           975
##  0.5898604875 -0.2791342233 -0.9534491375  0.0726792661  0.5660800547
##           976           977           978           979           980
##  1.5141066541  0.8077017630  0.2604531666 -0.2328108881 -0.2328108881
##           981           982           983           984           985
## -0.3053138356  1.4816189149  1.4816189149  0.4292766141 -0.6564535165
##           986           987           988           989           990
## -0.3394211656 -0.1249614634  1.3926030435  0.2200366675  1.4308145432
##           991           992           993           994           995
##  0.6219236332 -0.7011376946  1.1972641931 -0.5465378330 -0.5465378330
##           996           997           998           999          1000
## -0.5465378330 -0.5465378330  0.5042829721 -1.4890378650 -1.2332864778
##          1001          1002          1003          1004          1005
## -1.2332864778 -1.2332864778 -0.0247680797 -0.0247680797 -0.0247680797
##          1006          1007          1008          1009          1010
##  0.4190014773 -1.2890599402 -1.0706242282 -1.0706242282 -2.4261398056
##          1011          1012          1013          1014          1015
```

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## -2.2620460451 -0.8090566401 -0.8090566401  1.9123415447 -2.5013436293
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## -2.5013436293 -2.5013436293 -0.9321867971 -0.9321867971 -0.7659383130
##          1021          1022          1023          1024          1025
##  0.9560971832  1.2480564282  1.2480564282 -0.6077009540 -0.3452841771
##          1026          1027          1028          1029          1030
## -0.3019185274 -0.6846113116 -0.6364203134  1.5466903583  0.7316942220
##          1031          1032          1033          1034          1035
##  0.7520078845 -1.4576566888  0.6149647495  0.1489954925  0.1489954925
##          1036          1037          1038          1039          1040
## -1.4476892952 -0.7740317722  0.0736821106  0.0736821106  0.1620927461
##          1041          1042          1043          1044          1045
## -1.1922947983  0.0128177828  0.0128177828  0.0128177828  1.2654060584
##          1046          1047          1048          1049          1050
## -0.1775327939 -4.5769869941 -0.4477437721 -0.4477437721 -0.4477437721
##          1051          1052          1053          1054          1055
## -0.4477437721  0.3981168191  0.3981168191 -0.3720690733 -0.4643021004
##          1056          1057          1058          1059          1060
##  1.0364349595  0.2704663264 -0.4379848870 -1.1333140764 -1.1333140764
##          1061          1062          1063          1064          1065
##  1.5390125235  0.7081655096  0.5051021381  0.0646871556 -0.1777812518
##          1066          1067          1068          1069          1070
##  1.2497014786  1.2497014786  0.4046004285  0.3024003443  0.9733912994
##          1071          1072          1073          1074          1075
## -0.3138866634 -0.3138866634 -0.8068737061 -2.0539609911  1.1259193109
##          1076          1077          1078          1079          1080
##  0.1316036293 -0.0593943518 -0.4418139720 -0.4418139720  0.3672821007
##          1081          1082          1083          1084          1085
## -0.0756604227  1.3960388975  0.2414829301  0.6053926432  0.6053926432
##          1086          1087          1088          1089          1090
##  0.1581324163  0.1581324163 -1.1253141149 -0.4889604107 -0.4889604107
##          1091          1092          1093          1094          1095
## -0.4889604107 -0.9460319215  0.3978365517 -0.9334244720 -0.3515578660
##          1096          1097          1098          1099          1100
## -0.3515578660 -0.3515578660 -0.3111104837 -0.6529506965 -1.3708974089
##          1101          1102          1103          1104          1105
##  1.1113536763  0.4170974771  0.4652042844  0.4652042844 -0.8726897214
##          1106          1107          1108          1109          1110
##  0.0690057922  0.1523250476 -1.6826471438 -0.5756123578 -0.5756123578
##          1111          1112          1113          1114          1115
##  0.6185033330 -0.2091660974 -1.8402051192 -0.1908197281 -0.1908197281
##          1116          1117          1118          1119          1120
##  0.7819192833  2.4476047028  0.5223314344  0.7059505625 -0.4915890996
##          1121          1122          1123          1124          1125
##  0.4126004985  0.4126004985  0.6927282486  0.6927282486  0.6927282486
##          1126          1127          1128          1129          1130
## -1.0384364643 -1.4131299152 -0.2961635123 -0.9685909055 -0.5468385013
##          1131          1132          1133          1134          1135
##  0.5358625816 -0.4267379646 -0.4267379646 -0.4267379646 -0.4772481024
##          1136          1137          1138          1139          1140
## -0.2735557643 -0.2735557643  1.1139611173  1.1139611173  1.1139611173
##          1141          1142          1143          1144          1145
##  1.1139611173  0.6504286226  0.3852472547 -0.5014461862 -0.5014461862
##          1146          1147          1148          1149          1150
```

```
## -0.0024968036  1.3441566091  1.3441566091  1.3441566091  0.5437798286
##          1151          1152          1153          1154          1155
##  0.5437798286  1.0509761337  0.3715052720 -0.1196456843  0.2110926383
##          1156          1157          1158          1159          1160
##  0.2110926383 -0.2952547158 -0.1235875001  0.0960983783  0.0960983783
##          1161          1162          1163          1164          1165
## -0.3692603546  1.1465678630  0.9078826803 -0.3006099957 -0.0001432029
##          1166          1167          1168          1169          1170
## -0.0001432029 -0.0001432029 -0.0001432029 -2.4728965864 -2.4728965864
##          1171          1172          1173          1174          1175
## -1.2481573402  0.5111118940  0.5111118940 -0.9121315561 -0.9121315561
##          1176          1177          1178          1179          1180
## -1.3713750357  2.0455873670  1.2333477784 -1.4426956766 -1.3251374993
##          1181          1182          1183          1184          1185
## -1.3251374993  0.9356225934  1.2479092088  0.7605108593  0.7605108593
##          1186          1187          1188          1189          1190
## -0.8124420557  0.9746381073  0.9746381073 -1.5052269015 -1.3009553480
##          1191          1192          1193          1194          1195
## -0.4615158689  0.4137918705  0.4137918705  0.2993996791  0.9757907709
##          1196          1197          1198          1199          1200
## -0.4612446874 -0.4612446874 -1.5492523294 -0.7399137543  2.2903506782
##          1201          1202          1203          1204          1205
## -0.8568254199 -0.2997888564 -0.8419380409 -0.8419380409  0.0195765794
##          1206          1207          1208          1209          1210
## -0.8754936089 -0.9547759178  1.2167406208 -1.3061687208 -0.1593549061
##          1211          1212          1213          1214          1215
##  0.4562448490  0.7061547564  0.6357011889  0.2965858905 -0.3774542498
##          1216          1217          1218          1219          1220
## -1.8807425181 -1.8807425181 -1.8807425181  0.1093092468  0.1093092468
##          1221          1222          1223          1224          1225
##  0.4796241762  1.0461824150 -0.8273051787  0.1058825017  0.1058825017
##          1226          1227          1228          1229          1230
## -0.0359496939  0.1214439011  0.5116132395  1.0431079455  0.0077904801
##          1231          1232          1233          1234          1235
## -1.2123253741  0.7055811290  1.5126586992 -1.1668339149  0.6694036218
##          1236          1237          1238          1239          1240
##  0.0263009846  0.7646271609 -0.4256599497 -0.2499647732 -0.2499647732
##          1241          1242          1243          1244          1245
## -0.0227152448 -0.0227152448 -0.3250834274 -0.3250834274 -0.3250834274
##          1246          1247          1248          1249          1250
## -0.0825593665  1.4882081668  0.0367942320  0.0367942320 -0.6903318503
##          1251          1252          1253          1254          1255
## -0.4194430643 -0.4194430643 -0.4194430643 -0.4194430643  2.3110351022
##          1256          1257          1258          1259          1260
##  2.3110351022  2.3110351022 -0.0558281099 -0.2251332657  0.3091580591
##          1261          1262          1263          1264          1265
##  0.3091580591 -0.2070615064 -0.2070615064  0.2035708776 -0.8620424834
##          1266          1267          1268          1269          1270
## -0.2453848612 -0.4952438321  0.5311487932  2.4481158848  0.4848715918
##          1271          1272          1273          1274          1275
## -3.5561617018  0.7816933452  0.0053231703  0.0053231703  0.0053231703
##          1276          1277          1278          1279          1280
##  0.6973705811  1.0507167962  0.8947109233  1.0257421614  1.0257421614
##          1281          1282          1283          1284          1285
```

```
##   1.0257421614 -0.1400953943 -2.5498052179  0.9298020235 -1.8038682223
##           1286          1287          1288          1289          1290
## -1.1648107605 -1.1648107605 -1.0303848976  0.1987438799  0.1987438799
##           1291          1292          1293          1294          1295
## -0.1114911631 -1.0488179215 -1.0488179215  0.4646868800 -0.8296402702
##           1296          1297          1298          1299          1300
##   0.2808065268 -1.2442855293 -1.2442855293 -0.0065247305  1.7225689849
##           1301          1302          1303          1304          1305
##   1.7225689849  0.0439668811  0.0439668811 -1.0865153304 -1.0865153304
##           1306          1307          1308          1309          1310
##   1.3412759627 -0.9370392781 -0.9370392781 -0.9370392781 -0.2335903325
##           1311          1312          1313          1314          1315
## -1.7647242472 -0.0642442180 -0.7303085259  0.1133966365  0.1133966365
##           1316          1317          1318          1319          1320
##   0.1133966365  0.0163742036  0.1839365061  0.2532161687  0.0479266731
##           1321          1322          1323          1324          1325
##   0.0479266731  1.0582444881  1.0582444881  1.0582444881  0.9858202675
##           1326          1327          1328          1329          1330
## -0.2084274224 -0.8303882540  0.1020474049  0.1020474049  0.1020474049
##           1331          1332          1333          1334          1335
##   0.5968492010  0.5968492010  0.5968492010 -1.1372648352 -1.4931047657
##           1336          1337          1338          1339          1340
## -2.4508096375  1.5225176724  1.5225176724  1.5225176724 -0.4156941314
##           1341          1342          1343          1344          1345
## -1.3812554580 -1.3812554580  0.5113072598  0.5113072598  0.5113072598
##           1346          1347          1348          1349          1350
##   0.2598320421  0.7639105660  1.4935333605  1.4173961651  0.2838133080
##           1351          1352          1353          1354          1355
## -1.3471935487 -1.3471935487 -0.7937487421 -0.8194257752  0.3533544914
##           1356          1357          1358          1359          1360
##   0.3533544914 -1.4138125403  0.1443913972  1.0949319575  1.0949319575
##           1361          1362          1363          1364          1365
## -0.5525740749 -1.3522488110 -0.8501391453  0.7668076665 -0.3849232082
##           1366          1367          1368          1369          1370
## -0.3849232082 -1.2079204080  0.2465185609  0.2121845640  0.2121845640
##           1371          1372          1373          1374          1375
## -1.0178144674  1.4043541317 -0.1040024421 -0.3191082821  1.2657460190
##           1376          1377          1378          1379          1380
## -1.3913792671 -1.3768203887 -3.3226707962 -0.3157120086 -0.7730073259
##           1381          1382          1383          1384          1385
## -0.7730073259  0.0411715434 -0.0512990286  0.0284647709  1.1764554635
##           1386          1387          1388          1389
##   1.1764554635 -0.7015742241 -0.7015742241 -0.8482798443
```

```
## Outliers
outliers_index <- which(abs(st.residuals)>3)
outliers_index
```

```
##  191  476  787  879  880  890  968 1047 1271 1378
##  191  476  787  879  880  890  968 1047 1271 1378
```

```
#test commit
summary(reduced.model)
```

```
##
## Call:
```

```
## lm(formula = pb.TotChol ~ Age + pb.Age2 + Height + BPSysAve +
##     BPDiaAve, data = p.BXCX.frame)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.5043 -0.6322  0.0074  0.6457  3.8423
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.3844636  0.5574336   7.865 7.36e-15 ***
## Age          0.1016419  0.0105680   9.618  < 2e-16 ***
## pb.Age2     -0.0009697  0.0001068  -9.080  < 2e-16 ***
## Height      -0.0084564  0.0028590  -2.958 0.003151 **
## BPSysAve     0.0069601  0.0018049   3.856 0.000120 ***
## BPDiaAve     0.0094766  0.0024392   3.885 0.000107 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9865 on 1383 degrees of freedom
## Multiple R-squared:  0.121,  Adjusted R-squared:  0.1178
## F-statistic: 38.07 on 5 and 1383 DF,  p-value: < 2.2e-16
```

```r
#test commit
#test commit
#test commit #2
summary(NHANES)
```

```
##        ID          SurveyYr        Gender          Age          AgeDecade
##  Min.   :51624   2009_10:5000   female:5020   Min.   : 0.00   40-49  :1398
##  1st Qu.:56904   2011_12:5000   male  :4980   1st Qu.:17.00   0-9    :1391
##  Median :62160                                Median :36.00   10-19  :1374
##  Mean   :61945                                Mean   :36.74   20-29  :1356
##  3rd Qu.:67039                                3rd Qu.:54.00   30-39  :1338
##  Max.   :71915                                Max.   :80.00   (Other):2810
##                                                               NA's   : 333
##    AgeMonths          Race1           Race3              Education
##  Min.   :  0.0   Black  :1197   Asian   : 288   8th Grade    : 451
##  1st Qu.:199.0   Hispanic: 610  Black   : 589   9 - 11th Grade: 888
##  Median :418.0   Mexican :1015  Hispanic: 350   High School  :1517
##  Mean   :420.1   White  :6372   Mexican : 480   Some College :2267
##  3rd Qu.:624.0   Other  : 806   White   :3135   College Grad :2098
##  Max.   :959.0                  Other   : 158   NA's         :2779
##  NA's   :5038                   NA's    :5000
##    MaritalStatus        HHIncome        HHIncomeMid        Poverty
##  Divorced   : 707   more 99999 :2220   Min.   : 2500   Min.   :0.000
##  LivePartner: 560   75000-99999:1084   1st Qu.: 30000  1st Qu.:1.240
##  Married    :3945   25000-34999: 958   Median : 50000  Median :2.700
##  NeverMarried:1380  35000-44999: 863   Mean   : 57206  Mean   :2.802
##  Separated  : 183   45000-54999: 784   3rd Qu.: 87500  3rd Qu.:4.710
##  Widowed    : 456   (Other)    :3280   Max.   :100000  Max.   :5.000
##  NA's       :2769   NA's       : 811   NA's   :811     NA's   :726
##    HomeRooms        HomeOwn          Work            Weight
##  Min.   : 1.000   Own  :6425   Looking   : 311   Min.   : 2.80
##  1st Qu.: 5.000   Rent :3287   NotWorking:2847   1st Qu.: 56.10
##  Median : 6.000   Other: 225   Working   :4613   Median : 72.70
```

```
##  Mean   : 6.249   NA's :  63   NA's       :2229   Mean   : 70.98
##  3rd Qu.: 8.000                                   3rd Qu.: 88.90
##  Max.   :13.000                                   Max.   :230.70
##  NA's   :69                                       NA's   :78
##     Length          HeadCirc         Height           BMI
##  Min.   : 47.10   Min.   :34.20   Min.   : 83.6   Min.   :12.88
##  1st Qu.: 75.70   1st Qu.:39.58   1st Qu.:156.8   1st Qu.:21.58
##  Median : 87.00   Median :41.45   Median :166.0   Median :25.98
##  Mean   : 85.02   Mean   :41.18   Mean   :161.9   Mean   :26.66
##  3rd Qu.: 96.10   3rd Qu.:42.92   3rd Qu.:174.5   3rd Qu.:30.89
##  Max.   :112.20   Max.   :45.40   Max.   :200.4   Max.   :81.25
##  NA's   :9457     NA's   :9912    NA's   :353     NA's   :366
##    BMICatUnder20yrs       BMI_WHO         Pulse           BPSysAve
##  UnderWeight:  55    12.0_18.5   :1277   Min.   : 40.00   Min.   : 76.0
##  NormWeight : 805    18.5_to_24.9:2911   1st Qu.: 64.00   1st Qu.:106.0
##  OverWeight : 193    25.0_to_29.9:2664   Median : 72.00   Median :116.0
##  Obese      : 221    30.0_plus   :2751   Mean   : 73.56   Mean   :118.2
##  NA's       :8726    NA's        : 397   3rd Qu.: 82.00   3rd Qu.:127.0
##                                          Max.   :136.00   Max.   :226.0
##                                          NA's   :1437     NA's   :1449
##     BPDiaAve          BPSys1          BPDia1           BPSys2
##  Min.   :  0.00   Min.   : 72.0   Min.   :  0.00   Min.   : 76.0
##  1st Qu.: 61.00   1st Qu.:106.0   1st Qu.: 62.00   1st Qu.:106.0
##  Median : 69.00   Median :116.0   Median : 70.00   Median :116.0
##  Mean   : 67.48   Mean   :119.1   Mean   : 68.28   Mean   :118.5
##  3rd Qu.: 76.00   3rd Qu.:128.0   3rd Qu.: 76.00   3rd Qu.:128.0
##  Max.   :116.00   Max.   :232.0   Max.   :118.00   Max.   :226.0
##  NA's   :1449     NA's   :1763    NA's   :1763     NA's   :1647
##     BPDia2          BPSys3          BPDia3         Testosterone
##  Min.   :  0.00   Min.   : 76.0   Min.   :  0.0   Min.   :   0.25
##  1st Qu.: 60.00   1st Qu.:106.0   1st Qu.: 60.0   1st Qu.:  17.70
##  Median : 68.00   Median :116.0   Median : 68.0   Median :  43.82
##  Mean   : 67.66   Mean   :117.9   Mean   : 67.3   Mean   : 197.90
##  3rd Qu.: 76.00   3rd Qu.:126.0   3rd Qu.: 76.0   3rd Qu.: 362.41
##  Max.   :118.00   Max.   :226.0   Max.   :116.0   Max.   :1795.60
##  NA's   :1647     NA's   :1635    NA's   :1635    NA's   :5874
##    DirectChol       TotChol         UrineVol1        UrineFlow1
##  Min.   :0.390   Min.   : 1.530   Min.   :  0.0   Min.   : 0.0000
##  1st Qu.:1.090   1st Qu.: 4.110   1st Qu.: 50.0   1st Qu.: 0.4030
##  Median :1.290   Median : 4.780   Median : 94.0   Median : 0.6990
##  Mean   :1.365   Mean   : 4.879   Mean   :118.5   Mean   : 0.9793
##  3rd Qu.:1.580   3rd Qu.: 5.530   3rd Qu.:164.0   3rd Qu.: 1.2210
##  Max.   :4.030   Max.   :13.650   Max.   :510.0   Max.   :17.1670
##  NA's   :1526    NA's   :1526     NA's   :987     NA's   :1603
##    UrineVol2        UrineFlow2      Diabetes     DiabetesAge        HealthGen
##  Min.   :  0.0   Min.   : 0.000   No :9098   Min.   : 1.00   Excellent: 878
##  1st Qu.: 52.0   1st Qu.: 0.475   Yes : 760   1st Qu.:40.00   Vgood    :2508
##  Median : 95.0   Median : 0.760   NA's: 142   Median :50.00   Good     :2956
##  Mean   :119.7   Mean   : 1.149               Mean   :48.42   Fair     :1010
##  3rd Qu.:171.8   3rd Qu.: 1.513               3rd Qu.:58.00   Poor     : 187
##  Max.   :409.0   Max.   :13.692               Max.   :80.00   NA's     :2461
##  NA's   :8522    NA's   :8524                 NA's   :9371
##  DaysPhysHlthBad  DaysMentHlthBad  LittleInterest    Depressed
##  Min.   : 0.000   Min.   : 0.000   None  :5103     None  :5246
```

```
##  1st Qu.: 0.000   1st Qu.: 0.000   Several:1130   Several:1009
##  Median : 0.000   Median : 0.000   Most  : 434    Most  : 418
##  Mean  : 3.335    Mean  : 4.127    NA's  :3333    NA's  :3327
##  3rd Qu.: 3.000   3rd Qu.: 4.000
##  Max.  :30.000    Max.  :30.000
##  NA's  :2468      NA's  :2466
##   nPregnancies       nBabies       Age1stBaby    SleepHrsNight
##  Min.  : 1.000    Min.  : 0.000    Min.  :14.00   Min.  : 2.000
##  1st Qu.: 2.000   1st Qu.: 2.000   1st Qu.:19.00  1st Qu.: 6.000
##  Median : 3.000   Median : 2.000   Median :22.00  Median : 7.000
##  Mean  : 3.027    Mean  : 2.457    Mean  :22.65   Mean  : 6.928
##  3rd Qu.: 4.000   3rd Qu.: 3.000   3rd Qu.:26.00  3rd Qu.: 8.000
##  Max.  :32.000    Max.  :12.000    Max.  :39.00   Max.  :12.000
##  NA's  :7396      NA's  :7584      NA's  :8116    NA's  :2245
##  SleepTrouble PhysActive  PhysActiveDays       TVHrsDay         CompHrsDay
##  No  :5799    No  :3677   Min.  :1.000   2_hr     :1275   0_to_1_hr:1409
##  Yes :1973    Yes :4649   1st Qu.:2.000  1_hr     : 884   0_hrs    :1073
##  NA's:2228    NA's:1674   Median :3.000  3_hr     : 836   1_hr     :1030
##                           Mean  :3.744   0_to_1_hr: 638   2_hr     : 589
##                           3rd Qu.:5.000  More_4_hr: 615   3_hr     : 347
##                           Max.  :7.000   (Other)  : 611   (Other)  : 415
##                           NA's  :5337    NA's     :5141   NA's     :5137
##  TVHrsDayChild   CompHrsDayChild Alcohol12PlusYr   AlcoholDay
##  Min.  :0.000    Min.  :0.000    No  :1368      Min.  : 1.000
##  1st Qu.:1.000   1st Qu.:0.000   Yes :5212      1st Qu.: 1.000
##  Median :2.000   Median :1.000   NA's:3420      Median : 2.000
##  Mean  :1.939    Mean  :2.198                   Mean  : 2.914
##  3rd Qu.:3.000   3rd Qu.:6.000                  3rd Qu.: 3.000
##  Max.  :6.000    Max.  :6.000                   Max.  :82.000
##  NA's  :9347     NA's  :9347                    NA's  :5086
##   AlcoholYear     SmokeNow     Smoke100       Smoke100n        SmokeAge
##  Min.  :  0.0   No  :1745   No  :4024    Non-Smoker:4024   Min.  : 6.00
##  1st Qu.:  3.0  Yes :1466   Yes :3211    Smoker    :3211   1st Qu.:15.00
##  Median : 24.0  NA's:6789   NA's:2765    NA's      :2765   Median :17.00
##  Mean  : 75.1                                              Mean  :17.83
##  3rd Qu.:104.0                                             3rd Qu.:19.00
##  Max.  :364.0                                              Max.  :72.00
##  NA's  :4078                                               NA's  :6920
##  Marijuana   AgeFirstMarij   RegularMarij  AgeRegMarij    HardDrugs
##  No  :2049   Min.  : 1.00   No  :3575   Min.  : 5.00   No  :4700
##  Yes :2892   1st Qu.:15.00  Yes :1366   1st Qu.:15.00  Yes :1065
##  NA's:5059   Median :16.00  NA's:5059   Median :17.00  NA's:4235
##              Mean  :17.02               Mean  :17.69
##              3rd Qu.:19.00              3rd Qu.:19.00
##              Max.  :48.00               Max.  :52.00
##              NA's  :7109                NA's  :8634
##  SexEver         SexAge     SexNumPartnLife  SexNumPartYear    SameSex
##  No  : 223   Min.  : 9.00   Min.  :  0.00   Min.  : 0.000   No  :5353
##  Yes :5544   1st Qu.:15.00  1st Qu.:  2.00  1st Qu.: 1.000  Yes : 415
##  NA's:4233   Median :17.00  Median :  5.00  Median : 1.000  NA's:4232
##              Mean  :17.43   Mean  : 15.09   Mean  : 1.342
##              3rd Qu.:19.00  3rd Qu.: 12.00  3rd Qu.: 1.000
##              Max.  :50.00   Max.  :2000.00  Max.  :69.000
##              NA's  :4460    NA's  :4275     NA's  :5072
```

```
##         SexOrientation  PregnantNow
##  Bisexual    : 119   Yes    :  72
##  Heterosexual:4638   No     :1573
##  Homosexual  :  85   Unknown:  51
##  NA's        :5158   NA's   :8304
##
##
##
```