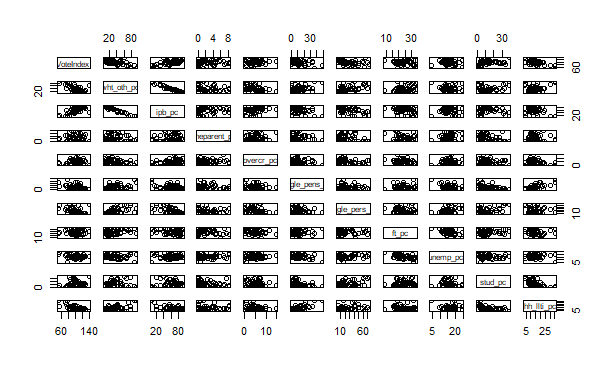
|  |
| --- |
| > library(foreign)  > my.data <- read.spss("UniWd-ED91data-Vote97.sav", to.data.frame = T)  re-encoding from CP1252  > names(my.data)  [1] "ed91" "Easting" "Northing" "area"  [5] "allppl" "VoteIndex" "wht\_oth\_pc" "ipb\_pc"  [9] "non\_home\_own\_pc" "no\_car\_pc" "overcr\_pc" "loneparent\_pc"  [13] "unemp\_pc" "single\_pens\_pc" "single\_pers\_pc" "ft\_pc"  [17] "stud\_pc" "hh\_llti\_pc" "Multi\_stress" "multistress"  > data <- my.data[, c(6, 7, 8, 12, 11, 14, 15, 16, 13, 17, 18)]  > names(data)  [1] "VoteIndex" "wht\_oth\_pc" "ipb\_pc" "loneparent\_pc"  [5] "overcr\_pc" "single\_pens\_pc" "single\_pers\_pc" "ft\_pc"  [9] "unemp\_pc" "stud\_pc" "hh\_llti\_pc"  > cor(data)  VoteIndex wht\_oth\_pc ipb\_pc loneparent\_pc overcr\_pc  VoteIndex 1.00000000 -0.66583472 0.690598459 -0.04371363 0.13886608  wht\_oth\_pc -0.66583472 1.00000000 -0.986733269 -0.06856849 -0.38789039  ipb\_pc 0.69059846 -0.98673327 1.000000000 0.01999824 0.36319629  loneparent\_pc -0.04371363 -0.06856849 0.019998241 1.00000000 0.17256918  overcr\_pc 0.13886608 -0.38789039 0.363196290 0.17256918 1.00000000  single\_pens\_pc -0.44347893 0.45587757 -0.452075767 0.01548303 -0.15950718  single\_pers\_pc -0.40895367 0.61348361 -0.634697589 -0.10860799 -0.24437602  ft\_pc -0.01561356 0.31988483 -0.263495028 -0.27268151 -0.23889567  unemp\_pc -0.16193265 -0.05875326 0.008113192 0.20018004 0.14211762  stud\_pc 0.22358665 0.04632974 -0.019016746 -0.26989027 -0.09711935  hh\_llti\_pc -0.59707990 0.45476817 -0.503695486 0.10273727 -0.21253288  single\_pens\_pc single\_pers\_pc ft\_pc unemp\_pc stud\_pc  VoteIndex -0.44347893 -0.40895367 -0.01561356 -0.161932645 0.22358665  wht\_oth\_pc 0.45587757 0.61348361 0.31988483 -0.058753262 0.04632974  ipb\_pc -0.45207577 -0.63469759 -0.26349503 0.008113192 -0.01901675  loneparent\_pc 0.01548303 -0.10860799 -0.27268151 0.200180042 -0.26989027  overcr\_pc -0.15950718 -0.24437602 -0.23889567 0.142117624 -0.09711935  single\_pens\_pc 1.00000000 -0.11196146 0.06889127 -0.386065937 -0.49439269  single\_pers\_pc -0.11196146 1.00000000 -0.09884376 0.409214653 0.41072160  ft\_pc 0.06889127 -0.09884376 1.00000000 -0.547473015 0.07265977  unemp\_pc -0.38606594 0.40921465 -0.54747302 1.000000000 -0.13234235  stud\_pc -0.49439269 0.41072160 0.07265977 -0.132342354 1.00000000  hh\_llti\_pc 0.74767377 0.03702067 -0.11597723 0.005109069 -0.55049546  hh\_llti\_pc  VoteIndex -0.597079903  wht\_oth\_pc 0.454768174  ipb\_pc -0.503695486  loneparent\_pc 0.102737267  overcr\_pc -0.212532876  single\_pens\_pc 0.747673773  single\_pers\_pc 0.037020669  ft\_pc -0.115977228  unemp\_pc 0.005109069  stud\_pc -0.550495465  hh\_llti\_pc 1.000000000  > round(cor(data), 3)  VoteIndex wht\_oth\_pc ipb\_pc loneparent\_pc overcr\_pc single\_pens\_pc  VoteIndex 1.000 -0.666 0.691 -0.044 0.139 -0.443  wht\_oth\_pc -0.666 1.000 -0.987 -0.069 -0.388 0.456  ipb\_pc 0.691 -0.987 1.000 0.020 0.363 -0.452  loneparent\_pc -0.044 -0.069 0.020 1.000 0.173 0.015  overcr\_pc 0.139 -0.388 0.363 0.173 1.000 -0.160  single\_pens\_pc -0.443 0.456 -0.452 0.015 -0.160 1.000  single\_pers\_pc -0.409 0.613 -0.635 -0.109 -0.244 -0.112  ft\_pc -0.016 0.320 -0.263 -0.273 -0.239 0.069  unemp\_pc -0.162 -0.059 0.008 0.200 0.142 -0.386  stud\_pc 0.224 0.046 -0.019 -0.270 -0.097 -0.494  hh\_llti\_pc -0.597 0.455 -0.504 0.103 -0.213 0.748  single\_pers\_pc ft\_pc unemp\_pc stud\_pc hh\_llti\_pc  VoteIndex -0.409 -0.016 -0.162 0.224 -0.597  wht\_oth\_pc 0.613 0.320 -0.059 0.046 0.455  ipb\_pc -0.635 -0.263 0.008 -0.019 -0.504  loneparent\_pc -0.109 -0.273 0.200 -0.270 0.103  overcr\_pc -0.244 -0.239 0.142 -0.097 -0.213  single\_pens\_pc -0.112 0.069 -0.386 -0.494 0.748  single\_pers\_pc 1.000 -0.099 0.409 0.411 0.037  ft\_pc -0.099 1.000 -0.547 0.073 -0.116  unemp\_pc 0.409 -0.547 1.000 -0.132 0.005  stud\_pc 0.411 0.073 -0.132 1.000 -0.550  hh\_llti\_pc 0.037 -0.116 0.005 -0.550 1.000  > abs(cor(data)) > 0.8  VoteIndex wht\_oth\_pc ipb\_pc loneparent\_pc overcr\_pc single\_pens\_pc  VoteIndex TRUE FALSE FALSE FALSE FALSE FALSE  wht\_oth\_pc FALSE TRUE TRUE FALSE FALSE FALSE  ipb\_pc FALSE TRUE TRUE FALSE FALSE FALSE  loneparent\_pc FALSE FALSE FALSE TRUE FALSE FALSE  overcr\_pc FALSE FALSE FALSE FALSE TRUE FALSE  single\_pens\_pc FALSE FALSE FALSE FALSE FALSE TRUE  single\_pers\_pc FALSE FALSE FALSE FALSE FALSE FALSE  ft\_pc FALSE FALSE FALSE FALSE FALSE FALSE  unemp\_pc FALSE FALSE FALSE FALSE FALSE FALSE  stud\_pc FALSE FALSE FALSE FALSE FALSE FALSE  hh\_llti\_pc FALSE FALSE FALSE FALSE FALSE FALSE  single\_pers\_pc ft\_pc unemp\_pc stud\_pc hh\_llti\_pc  VoteIndex FALSE FALSE FALSE FALSE FALSE  wht\_oth\_pc FALSE FALSE FALSE FALSE FALSE  ipb\_pc FALSE FALSE FALSE FALSE FALSE  loneparent\_pc FALSE FALSE FALSE FALSE FALSE  overcr\_pc FALSE FALSE FALSE FALSE FALSE  single\_pens\_pc FALSE FALSE FALSE FALSE FALSE  single\_pers\_pc TRUE FALSE FALSE FALSE FALSE  ft\_pc FALSE TRUE FALSE FALSE FALSE  unemp\_pc FALSE FALSE TRUE FALSE FALSE  stud\_pc FALSE FALSE FALSE TRUE FALSE  hh\_llti\_pc FALSE FALSE FALSE FALSE TRUE  > plot(data) |
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|  |
| --- |
| > attach(data)  > model.1 <- lm(VoteIndex ~ ipb\_pc + stud\_pc)  > summary(model.1)  Call:  lm(formula = VoteIndex ~ ipb\_pc + stud\_pc)  Residuals:  Min 1Q Median 3Q Max  -20.546 -7.790 -1.478 8.635 40.580  Coefficients:  Estimate Std. Error t value Pr(>|t|)  (Intercept) 60.64146 5.80417 10.448 7.64e-14 \*\*\*  ipb\_pc 0.56088 0.08045 6.972 9.02e-09 \*\*\*  stud\_pc 0.45016 0.18953 2.375 0.0217 \*  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1  Residual standard error: 12.33 on 47 degrees of freedom  Multiple R-squared: 0.533, Adjusted R-squared: 0.5131  F-statistic: 26.82 on 2 and 47 DF, p-value: 1.696e-08  > detach(data)  > coef(model.1)  (Intercept) ipb\_pc stud\_pc  60.6414578 0.5608792 0.4501604 |
|  |
| |  | | --- | | > | |

> attach(data)

> model.2 <- lm(VoteIndex ~ ipb\_pc + stud\_pc + hh\_llti\_pc)

> summary(model.2)

Call:

lm(formula = VoteIndex ~ ipb\_pc + stud\_pc + hh\_llti\_pc)

Residuals:

Min 1Q Median 3Q Max

-23.613 -7.340 -0.634 7.673 37.507

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 81.49880 12.77288 6.381 7.77e-08 \*\*\*

ipb\_pc 0.44899 0.09969 4.504 4.55e-05 \*\*\*

stud\_pc 0.16302 0.24304 0.671 0.506

hh\_llti\_pc -0.72591 0.39841 -1.822 0.075 .

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 12.04 on 46 degrees of freedom

Multiple R-squared: 0.5644, Adjusted R-squared: 0.536

F-statistic: 19.87 on 3 and 46 DF, p-value: 2.097e-08

> detach(data)

> attach(data)

> model.2a <- lm(VoteIndex ~ ipb\_pc + stud\_pc + hh\_llti\_pc, x=TRUE, y=TRUE)

> sd.x <- sd(model.2a$x);

> sd.y <- sd(model.2a$y);

> std.coef <- coef(model.2a) \* (sd.x / sd.y);

> coef.table <- as.data.frame(summary(model.2a)$coefficients);

> coef.table <- cbind(coef.table, std.coef);

> coef.table

Estimate Std. Error t value Pr(>|t|) std.coef

(Intercept) 81.4988003 12.77288043 6.3806125 7.767102e-08 118.9807789

ipb\_pc 0.4489874 0.09969369 4.5036694 4.548986e-05 0.6554805

stud\_pc 0.1630182 0.24303813 0.6707514 5.057330e-01 0.2379916

hh\_llti\_pc -0.7259104 0.39841017 -1.8220178 7.495751e-02 -1.0597627

> detach(data)

> attach(data)

> model.3 <- lm(VoteIndex ~ ipb\_pc + hh\_llti\_pc)

> summary(model.3)

Call:

lm(formula = VoteIndex ~ ipb\_pc + hh\_llti\_pc)

Residuals:

Min 1Q Median 3Q Max

-25.574 -7.376 -0.300 7.144 39.115

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 87.79952 8.60416 10.204 1.66e-13 \*\*\*

ipb\_pc 0.42151 0.09036 4.665 2.59e-05 \*\*\*

hh\_llti\_pc -0.89920 0.30152 -2.982 0.00452 \*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 11.97 on 47 degrees of freedom

Multiple R-squared: 0.5602, Adjusted R-squared: 0.5414

F-statistic: 29.93 on 2 and 47 DF, p-value: 4.145e-09

> detach(data)

|  |
| --- |
| > attach(data)  > model.4 <- lm(VoteIndex ~ ipb\_pc + hh\_llti\_pc + single\_pers\_pc)  > summary(model.4)  Call:  lm(formula = VoteIndex ~ ipb\_pc + hh\_llti\_pc + single\_pers\_pc)  Residuals:  Min 1Q Median 3Q Max  -24.362 -6.830 -0.879 6.717 40.606  Coefficients:  Estimate Std. Error t value Pr(>|t|)  (Intercept) 98.0528 13.7243 7.144 5.54e-09 \*\*\*  ipb\_pc 0.3331 0.1291 2.581 0.01312 \*  hh\_llti\_pc -1.0345 0.3331 -3.106 0.00325 \*\*  single\_pers\_pc -0.1194 0.1245 -0.959 0.34234  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1  Residual standard error: 11.98 on 46 degrees of freedom  Multiple R-squared: 0.5688, Adjusted R-squared: 0.5407  F-statistic: 20.23 on 3 and 46 DF, p-value: 1.669e-08  > detach(data) |
|  |
| |  | | --- | | > | |
| > names(my.data)  [1] "ed91" "Easting" "Northing" "area"  [5] "allppl" "VoteIndex" "wht\_oth\_pc" "ipb\_pc"  [9] "non\_home\_own\_pc" "no\_car\_pc" "overcr\_pc" "loneparent\_pc"  [13] "unemp\_pc" "single\_pens\_pc" "single\_pers\_pc" "ft\_pc"  [17] "stud\_pc" "hh\_llti\_pc" "Multi\_stress" "multistress"  > data <- my.data[, c(6, 7, 8, 12, 11, 14, 15, 16, 13, 17, 18, 20)]  > attach(data)  > model.5 <- lm(VoteIndex ~ ipb\_pc + hh\_llti\_pc + multistress)  > summary(model.5)  Call:  lm(formula = VoteIndex ~ ipb\_pc + hh\_llti\_pc + multistress)  Residuals:  Min 1Q Median 3Q Max  -21.422 -7.537 0.230 6.753 37.014  Coefficients:  Estimate Std. Error t value Pr(>|t|)  (Intercept) 86.78200 8.21966 10.558 7.04e-14 \*\*\*  ipb\_pc 0.47743 0.08936 5.343 2.76e-06 \*\*\*  hh\_llti\_pc -0.61537 0.31149 -1.976 0.0542 .  multistressMultiple stress -9.08088 3.82365 -2.375 0.0218 \*  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1  Residual standard error: 11.42 on 46 degrees of freedom  Multiple R-squared: 0.6082, Adjusted R-squared: 0.5826  F-statistic: 23.8 on 3 and 46 DF, p-value: 1.899e-09 |
|  |
| |  | | --- | | > | |

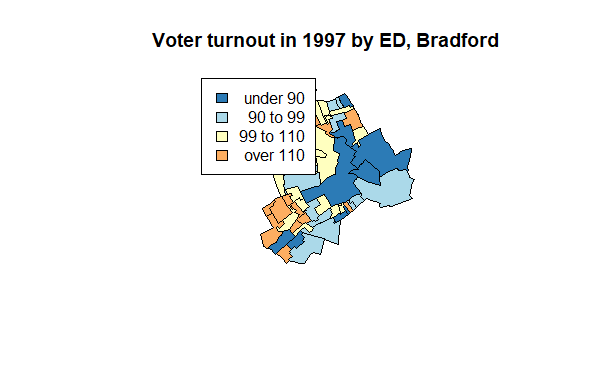
detach(data)

|  |
| --- |
| > as.vector(data$VoteIndex - predict(model.5))  [1] -4.80584238 -7.89841274 9.76911528 4.30268356 4.39115728 -17.14065206  [7] 13.22651312 3.31956781 -13.50843287 -5.86513344 -21.42201121 -4.79222724  [13] 11.23418726 8.21906970 0.54673898 5.45990760 5.13697698 -1.78525805  [19] 17.66583300 -13.98878518 1.40574486 0.72668003 -7.22919672 8.44453968  [25] 1.16809666 10.25269584 0.90163740 -2.78010264 6.89844606 -10.95542142  [31] -11.15427416 -7.43968759 8.49183668 -9.96298526 -2.20782304 6.31566687  [37] -0.08752725 37.01428972 -7.56987496 9.44265676 -0.95466276 -10.25266852  [43] 2.81576606 -14.19264908 22.91951693 -1.61743131 -18.97374953 11.92793082  [49] -12.71895631 -2.69348924  > resid(model.5)  1 2 3 4 5 6  -4.80584238 -7.89841274 9.76911528 4.30268356 4.39115728 -17.14065206  7 8 9 10 11 12  13.22651312 3.31956781 -13.50843287 -5.86513344 -21.42201121 -4.79222724  13 14 15 16 17 18  11.23418726 8.21906970 0.54673898 5.45990760 5.13697698 -1.78525805  19 20 21 22 23 24  17.66583300 -13.98878518 1.40574486 0.72668003 -7.22919672 8.44453968  25 26 27 28 29 30  1.16809666 10.25269584 0.90163740 -2.78010264 6.89844606 -10.95542142  31 32 33 34 35 36  -11.15427416 -7.43968759 8.49183668 -9.96298526 -2.20782304 6.31566687  37 38 39 40 41 42  -0.08752725 37.01428972 -7.56987496 9.44265676 -0.95466276 -10.25266852  43 44 45 46 47 48  2.81576606 -14.19264908 22.91951693 -1.61743131 -18.97374953 11.92793082  49 50  -12.71895631 -2.69348924 |
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| --- |
| > cbind(my.data[1:2, c(1,6)], predict(model.5)[1:2], resid(model.5)[1:2])  ed91 VoteIndex predict(model.5)[1:2] resid(model.5)[1:2]  1 08CXGD01 106.49 111.29584 -4.805842  2 08CXGD02 85.10 92.99841 -7.898413 |
|  |
| |  | | --- | | > | |
| > library(GISTools)  > my.shp <- readShapePoly("uni91edspolygons.shp")  Warning message:  use rgdal::readOGR or sf::st\_read  > my.shp@data = data.frame(my.shp@data,  + my.data[match(my.shp@data$ED91, my.data$ed91),])  > attach(data.frame(my.shp))  > model.5 <- lm(VoteIndex ~ ipb\_pc + hh\_llti\_pc + multistress)  > summary(model.5)  Call:  lm(formula = VoteIndex ~ ipb\_pc + hh\_llti\_pc + multistress)  Residuals:  Min 1Q Median 3Q Max  -21.422 -7.537 0.230 6.753 37.014  Coefficients:  Estimate Std. Error t value Pr(>|t|)  (Intercept) 86.78200 8.21966 10.558 7.04e-14 \*\*\*  ipb\_pc 0.47743 0.08936 5.343 2.76e-06 \*\*\*  hh\_llti\_pc -0.61537 0.31149 -1.976 0.0542 .  multistressMultiple stress -9.08088 3.82365 -2.375 0.0218 \*  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1  Residual standard error: 11.42 on 46 degrees of freedom  Multiple R-squared: 0.6082, Adjusted R-squared: 0.5826  F-statistic: 23.8 on 3 and 46 DF, p-value: 1.899e-09 |
|  |
| |  | | --- | | > | |

> detach(data.frame(my.shp))

|  |
| --- |
| > shades = auto.shading(my.shp$VoteIndex,  + cols= rev(brewer.pal(5,'RdYlBu')))  > choropleth(my.shp, my.shp$VoteIndex, shades)  > choro.legend(413114.7, 434758.4, shades)  > title("Voter turnout in 1997 by ED, Bradford") |
|  |
| |  | | --- | | > | |



|  |
| --- |
| > shades = auto.shading(resid(model.5),  + cols= rev(brewer.pal(5,'RdYlBu')))  > choropleth(my.shp, resid(model.5), shades)  > choro.legend(413114.7, 434758.4, shades)  > title(main = "Model residuals",  + sub = "Red, voter turnout was higher  + than the model predicts. Blue, turnout  + is lower than the model predicts") |
|  |
| |  | | --- | | > | |

