Appendix

Table I.1.2.1 Summary statistics

	PRECIP	EDUC	NONWHITE	POOR	NOX	SO2	MORTALITY
Min.	10.00	9.00	0.80	9.40	1.00	1.00	790.7
1st Qu.	32.75	10.40	4.95	12.00	4.00	11.00	898.4
Median	38.00	11.05	10.40	13.20	9.00	30.00	943.7
Mean	37.37	10.97	11.87	14.37	22.65	53.77	940.4
3rd Qu.	43.25	11.50	15.65	15.15	23.75	69.00	983.2
Max.	60.00	12.30	38.50	26.40	319.00	278.00	1113.0

Figure I.1.2.1 Histogram of each variable

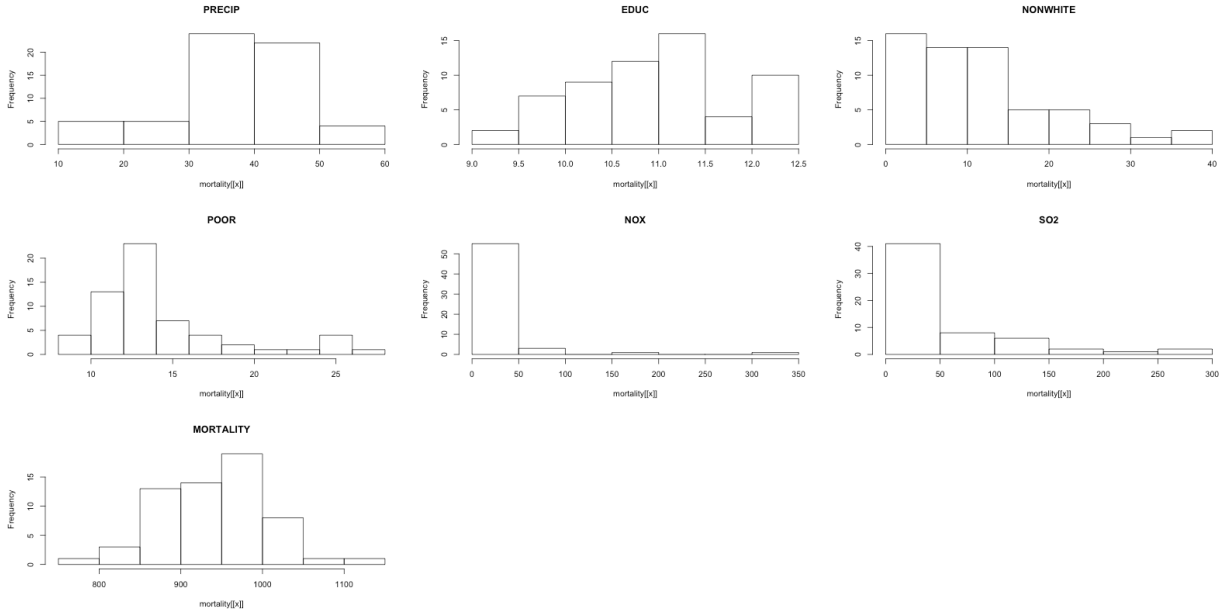


Table I.1.2.2 Single linear regression results summary

	Estimate	Std. Error	t value	Pr(>|t|)	R square
PRECIP	**3.174**	**0.7039**	**4.509**	**3.22e-05**	**0.2596**
EDUC	**-37.601**	**8.306**	**-4.527**	**3.02e-05**	**0.2611**
NONWHITE	**4.4884**	**0.7006**	**6.406**	**2.89e-08**	**0.4144**
POOR	**6.137**	**1.79**	**3.428**	**0.00112**	**0.1685**
NOX	**-0.1039**	**0.1757**	**-0.591**	**0.557**	**0.005988**
SO2	**0.418**	**0.1166**	**3.585**	**0.000691**	**0.1814**

Figure I.1.3.1 Histogram of possible transformations

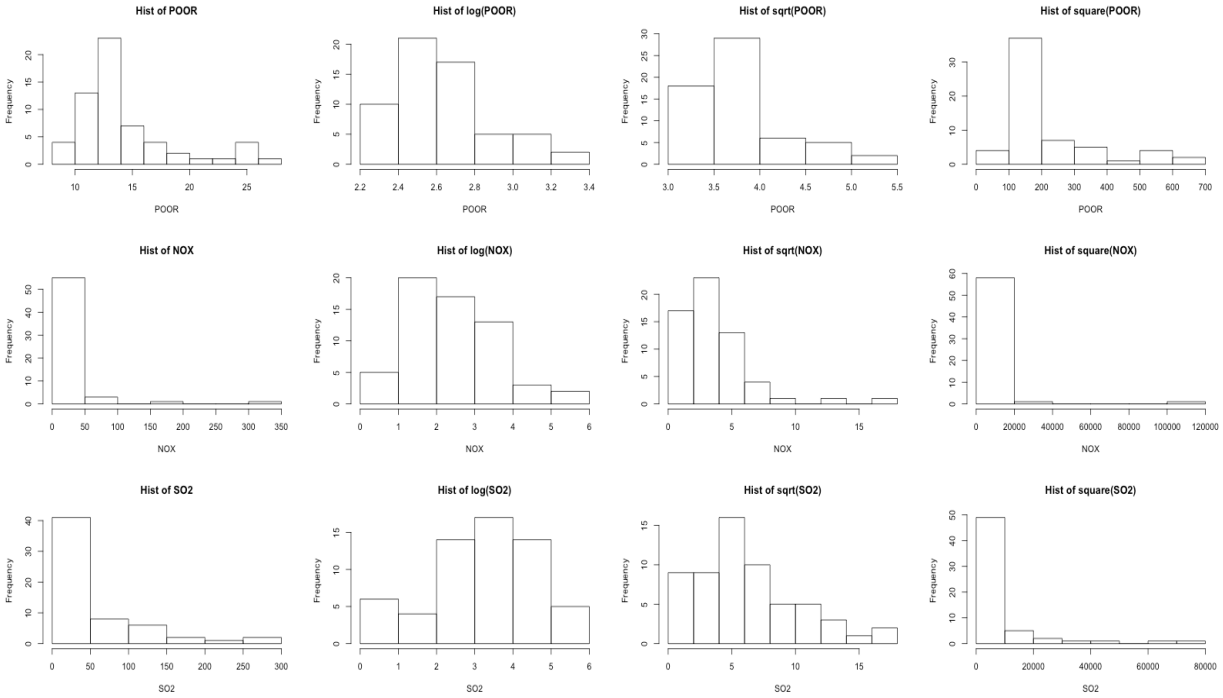


Table I.1.3.1 Correlation matrix

	PRECIP	EDUC	NONWHITE	POOR	NOX
PRECIP	1.0000000	-0.49042518	0.34931594	0.50658543	-0.36830267
EDUC	-0.4904252	1.00000000	-0.15861781	-0.40333845	0.01798472
NONWHITE	0.3493159	-0.15861781	1.00000000	0.64267418	0.19583176
POOR	0.5065854	-0.40333845	0.64267418	1.00000000	-0.09027348
NOX	-0.3683027	0.01798472	0.19583176	-0.09027348	1.00000000
SO2	-0.1211723	-0.25616219	0.05780639	-0.19336723	0.73280742
MORTALITY	0.5094924	-0.51098130	0.62366084	0.41045399	0.29199967

	SO2	MORTALITY
PRECIP	-0.12117231	0.5094924
EDUC	-0.25616219	-0.5109813
NONWHITE	0.05780639	0.6236608
POOR	-0.19336723	0.4104540
NOX	0.73280742	0.2919997
SO2	1.00000000	0.4031300
MORTALITY	0.40313003	1.0000000

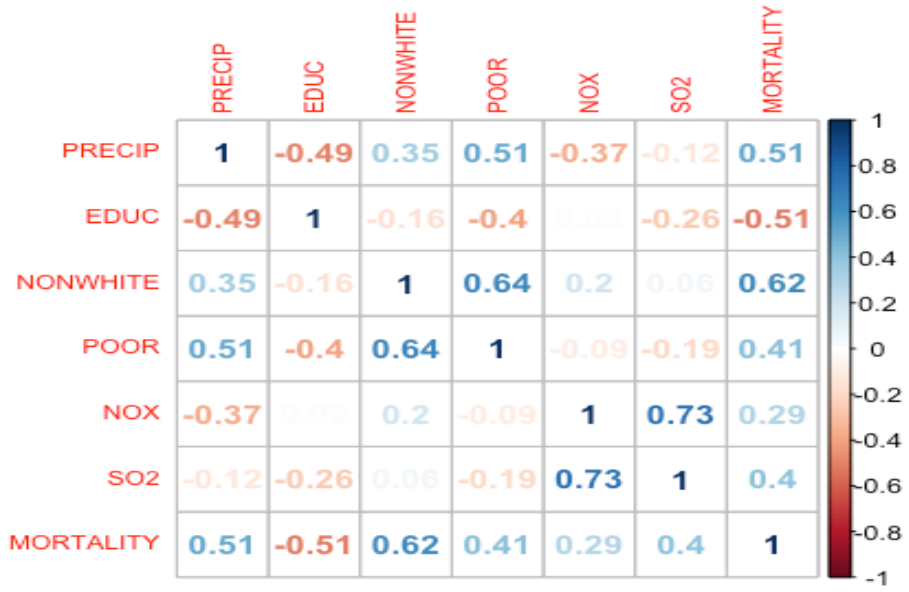
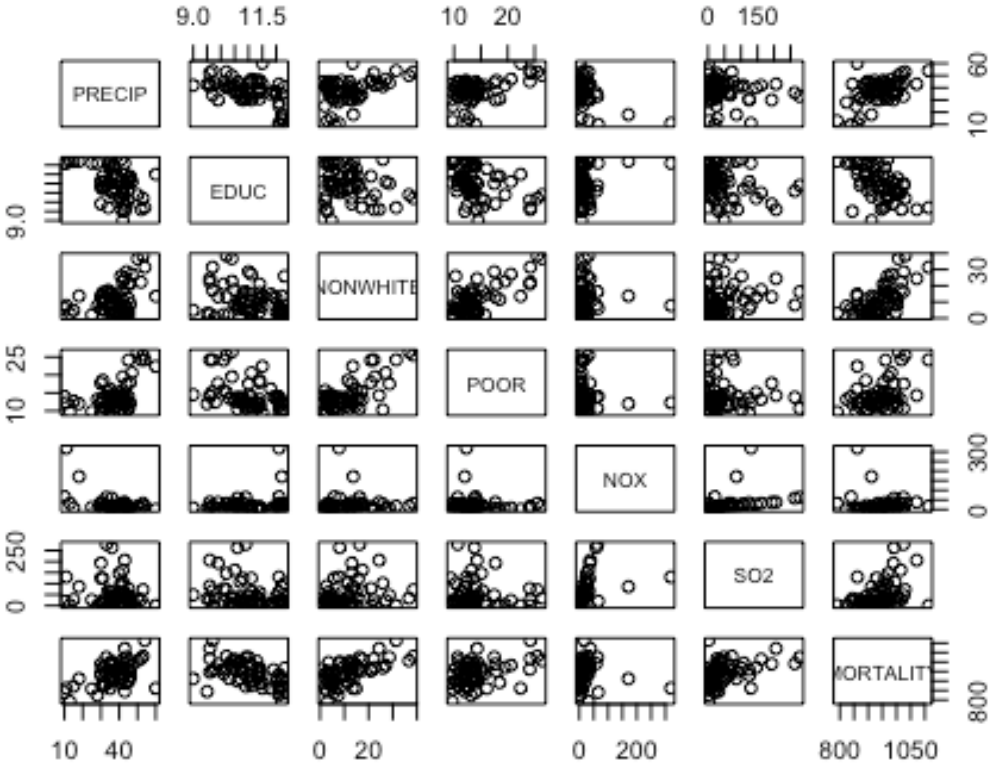


Figure I.1.3.2 Matrix plot



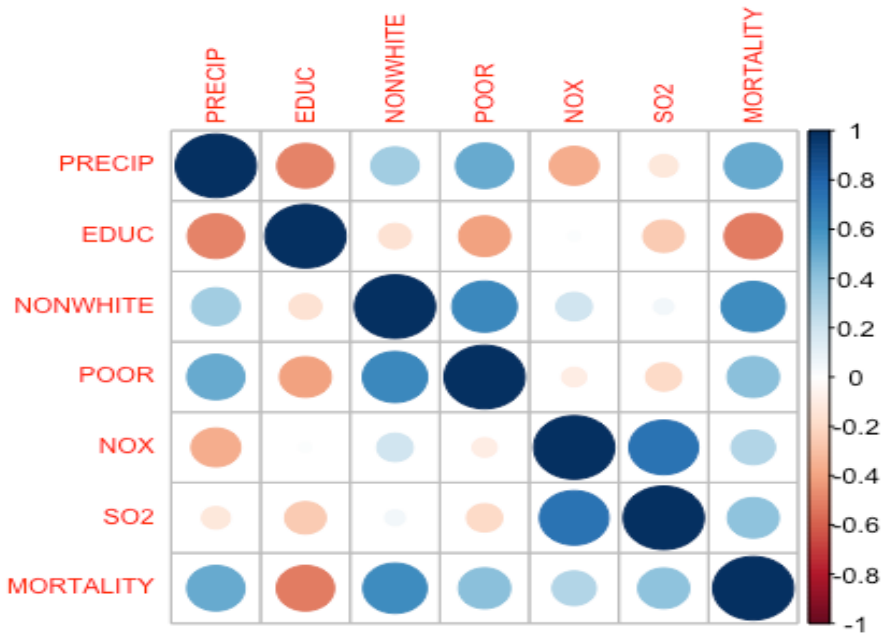


Table I.1.3.2 VIF

	PRECIP	EDUC	NONWHITE	POOR	NOX	SO2
VIF	2.114044	1.871773	2.127563	2.680043	3.381715	3.272394

Table II.2.1.1 Stepwise regression (first order)

```
## Step:  AIC=-61.03
## MORTALITY ~ NONWHITE + EDUC + SO2 + PRECIP
##
##             Df Sum of Sq     RSS     AIC
## <none>                    18.366 -61.031
## + NOX        1    0.4283 17.938 -60.447
## + POOR       1    0.3862 17.980 -60.306
## - EDUC       1    1.5853 19.951 -58.064
## - PRECIP     1    3.0516 21.417 -53.809
## - SO2        1    6.4080 24.774 -45.074
## - NONWHITE   1   11.2504 29.616 -34.361

##
## Call:
## lm(formula = MORTALITY ~ NONWHITE + EDUC + SO2 + PRECIP, data =
mortality_std)
##
## Coefficients:
## (Intercept)     NONWHITE         EDUC          SO2       PRECIP
##   3.322e-16    4.696e-01   -2.024e-01    3.593e-01    2.897e-01
```

Figure II.2.1.1 Residual plots for first order regression models

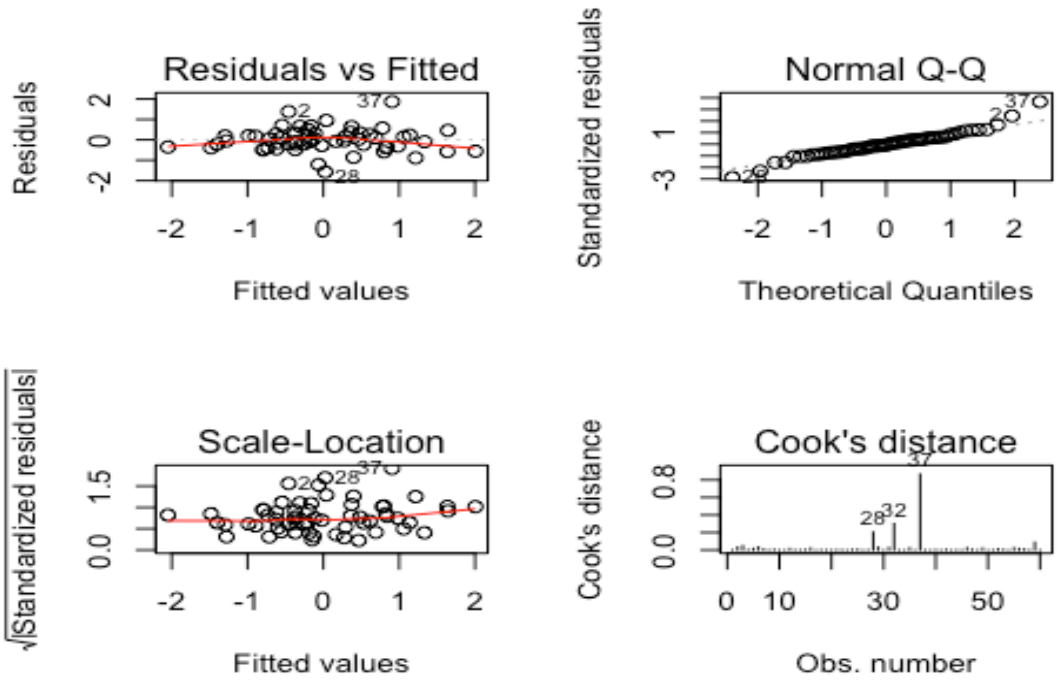


Table II.2.1.2 Stepwise regression (second order)

```
## Step:  AIC=-68.03
## MORTALITY ~ NONWHITE + EDUC + SO2 + PRECIP + NONWHITE:SO2 + EDUC:SO2
+
##     SO2:PRECIP
##
##                    Df Sum of Sq     RSS     AIC
## <none>                           14.788 -68.030
## + EDUC:NONWHITE     1   0.44327 14.345 -67.856
## + POOR              1   0.41002 14.378 -67.717
## - SO2:PRECIP        1   0.66771 15.456 -67.381
## + PRECIP:EDUC       1   0.32327 14.465 -67.356
## + PRECIP:NONWHITE   1   0.12835 14.660 -66.553
## + NOX               1   0.03115 14.757 -66.157
## - EDUC:SO2          1   1.07945 15.868 -65.803
## - NONWHITE:SO2      1   1.46619 16.255 -64.358

##
## Call:
## lm(formula = MORTALITY ~ NONWHITE + EDUC + SO2 + PRECIP +
NONWHITE:SO2 +
##     EDUC:SO2 + SO2:PRECIP, data = mortality_std)
##
## Coefficients:
##  (Intercept)      NONWHITE          EDUC           SO2        PRECIP
##      0.07058       0.47763      -0.19947       0.41399       0.28651
## NONWHITE:SO2      EDUC:SO2    SO2:PRECIP
##     -0.23873       0.16954       0.12004
```

Figure II.2.1.2 Residual plots for second order regression models

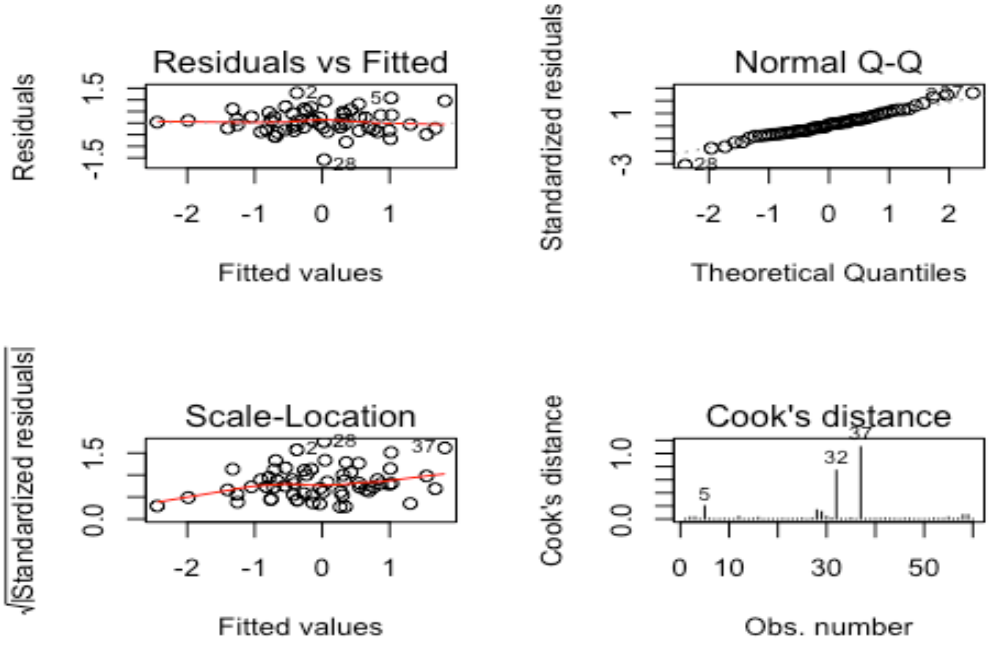


Figure II.2.2.1 Ridge regression lambda

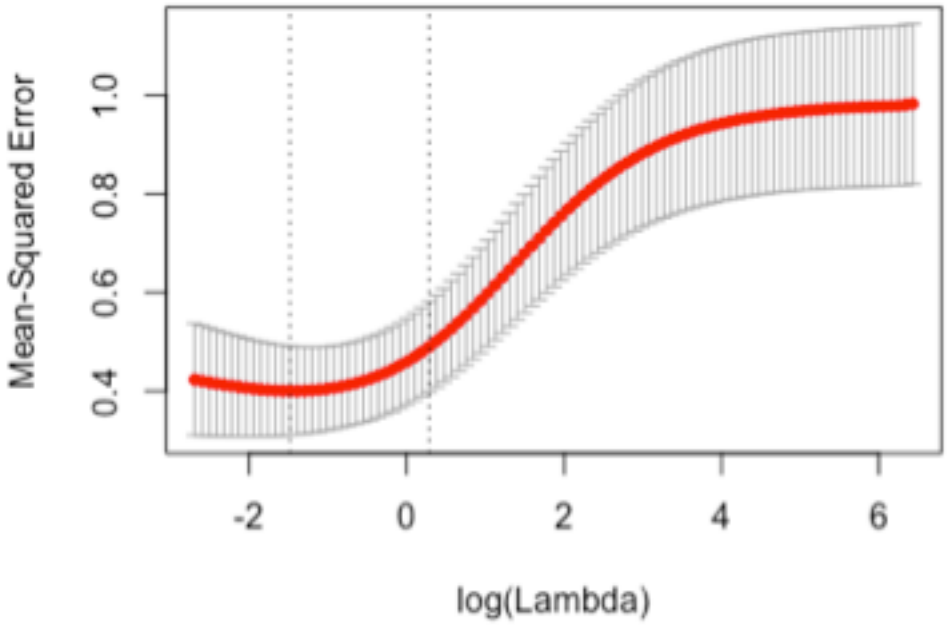


Figure II.2.2.2 Residual plot of ridge regression

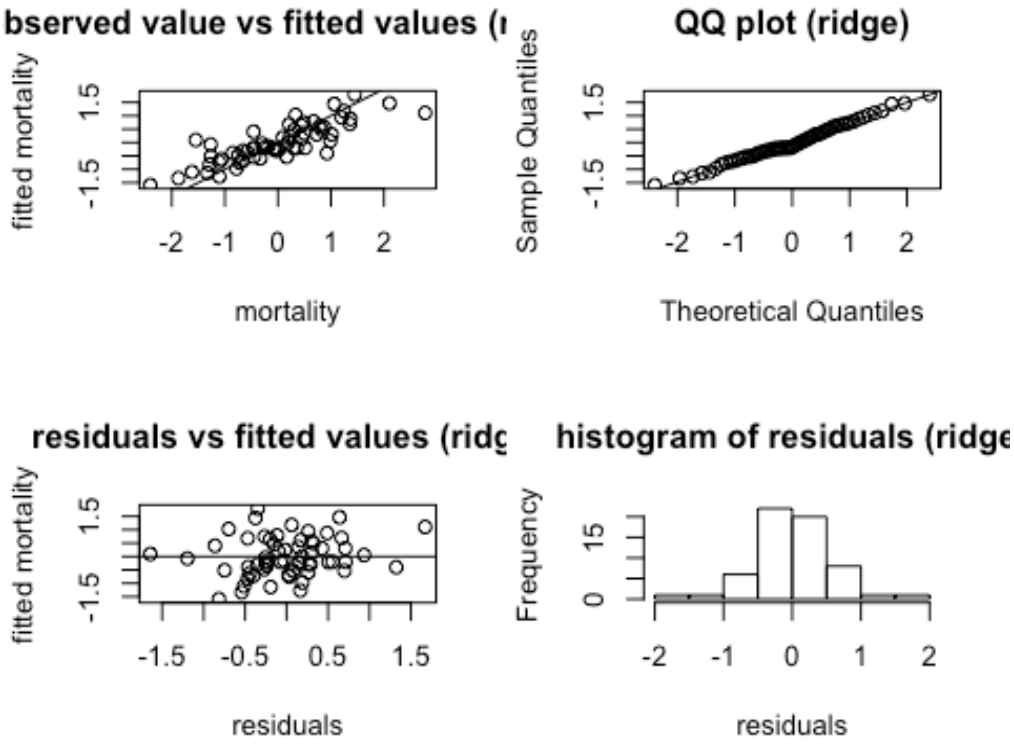


Figure II.2.3.1 Ridge regression lambda

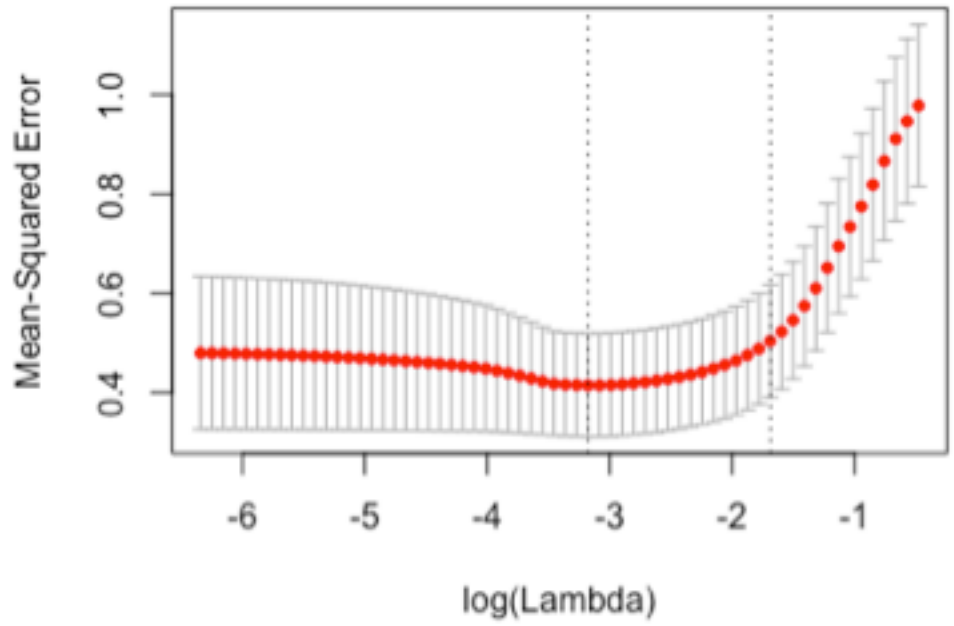


Figure II.2.3.2 Residual plot of lasso regression

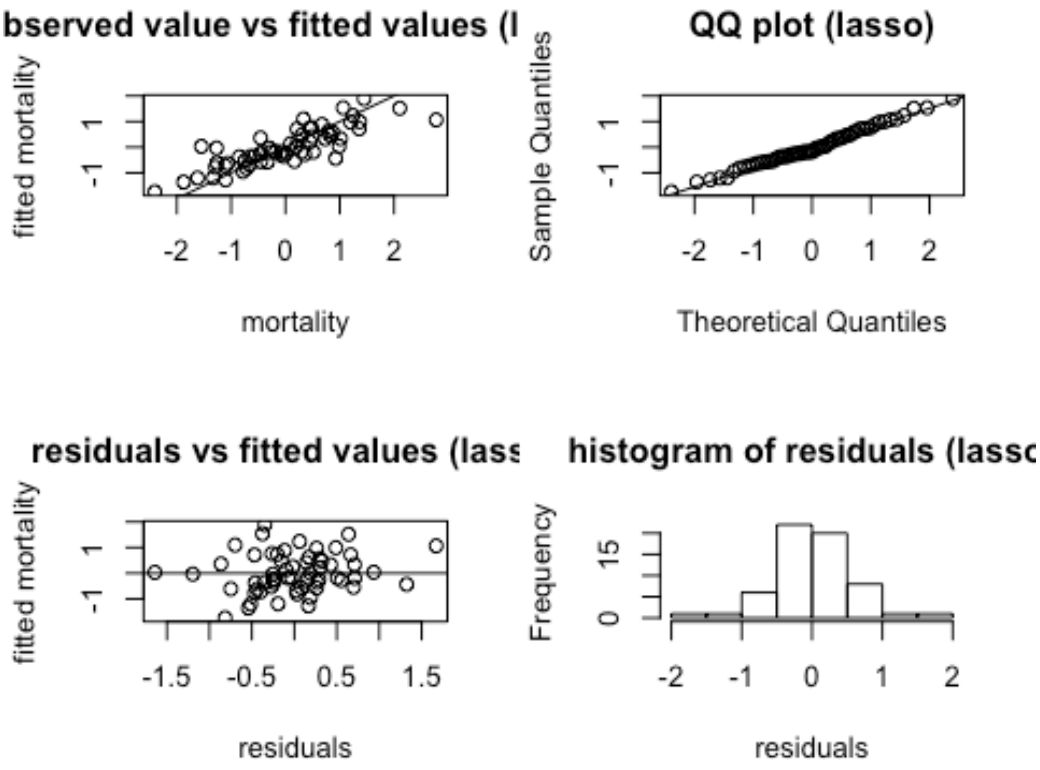


Table II.2.4.1 PLS

```
## Data:    X dimension: 60 6
##  Y dimension: 60 1
## Fit method: kernelpls
## Number of components considered: 5
##
## VALIDATION: RMSEP
## Cross-validated using 10 random segments.
##        (Intercept)  1 comps  2 comps  3 comps  4 comps  5 comps
## CV           1.008   0.6402   0.6428   0.6538   0.6440   0.6699
## adjCV        1.008   0.6375   0.6405   0.6476   0.6394   0.6630
##
## TRAINING: % variance explained
##             1 comps  2 comps  3 comps  4 comps  5 comps
## X             35.48    64.84    76.44    88.02    97.12
## MORTALITY     64.10    67.32    70.10    70.40    70.54
```

Figure II.2.4.1 Residual plot of PLS

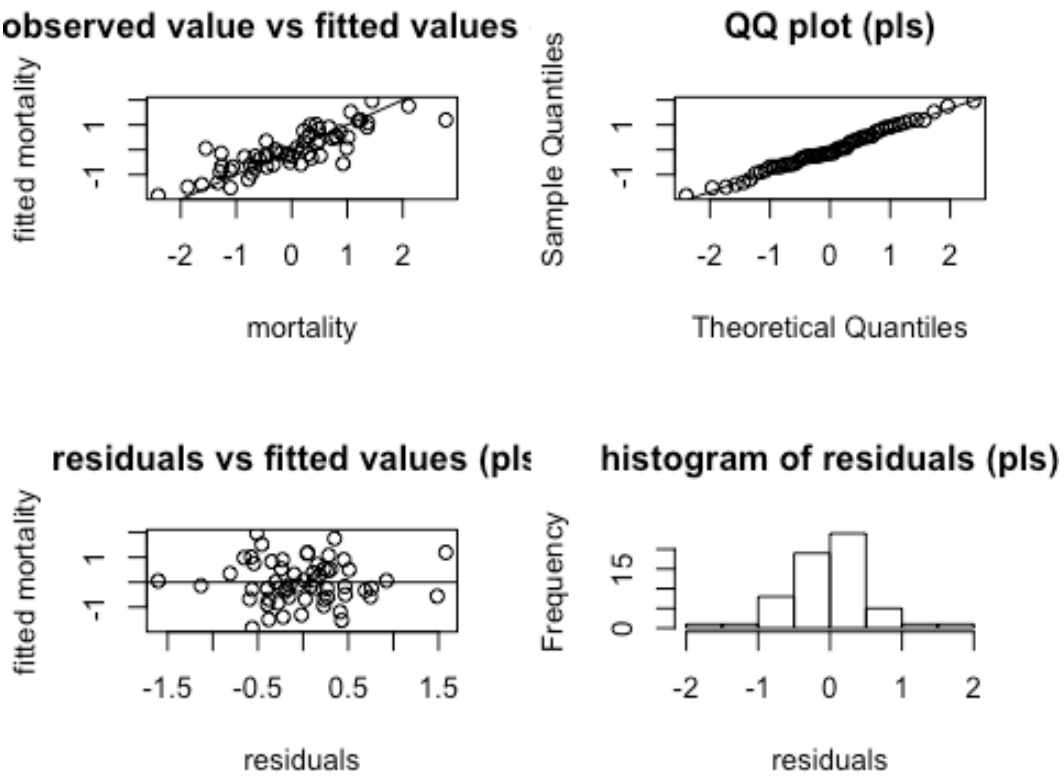


Table II.2.4.2 Loadings

```
## Loadings:
##           Comp 1 Comp 2 Comp 3 Comp 4
## PRECIP     0.432 -0.322  0.703 -0.545
## EDUC      -0.472  0.123  0.104  0.484
## NONWHITE   0.515         0.176  0.894
## POOR       0.492 -0.560 -0.301  0.111
## NOX        0.200  0.676 -0.603  0.292
## SO2        0.270  0.756 -0.286 -0.403
##
##                Comp 1 Comp 2 Comp 3 Comp 4
## SS loadings     1.029  1.465  1.073  1.590
## Proportion Var  0.172  0.244  0.179  0.265
## Cumulative Var  0.172  0.416  0.595  0.860
```

Figure II.4.1 Residual plots for final model

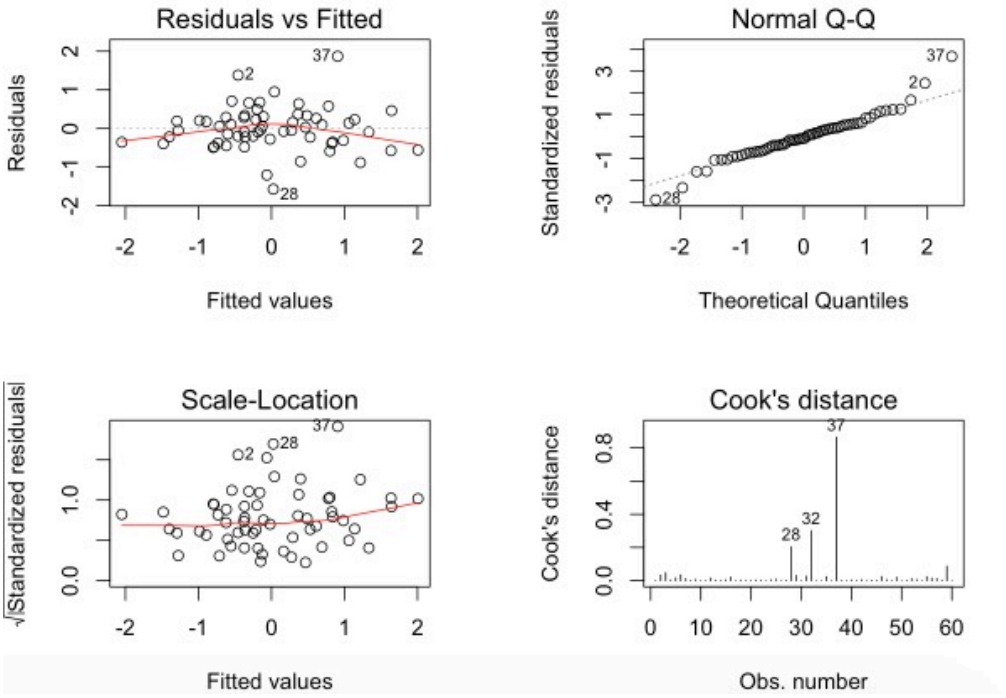


Figure II.4.2 Residual plots for final model after deleting outlier

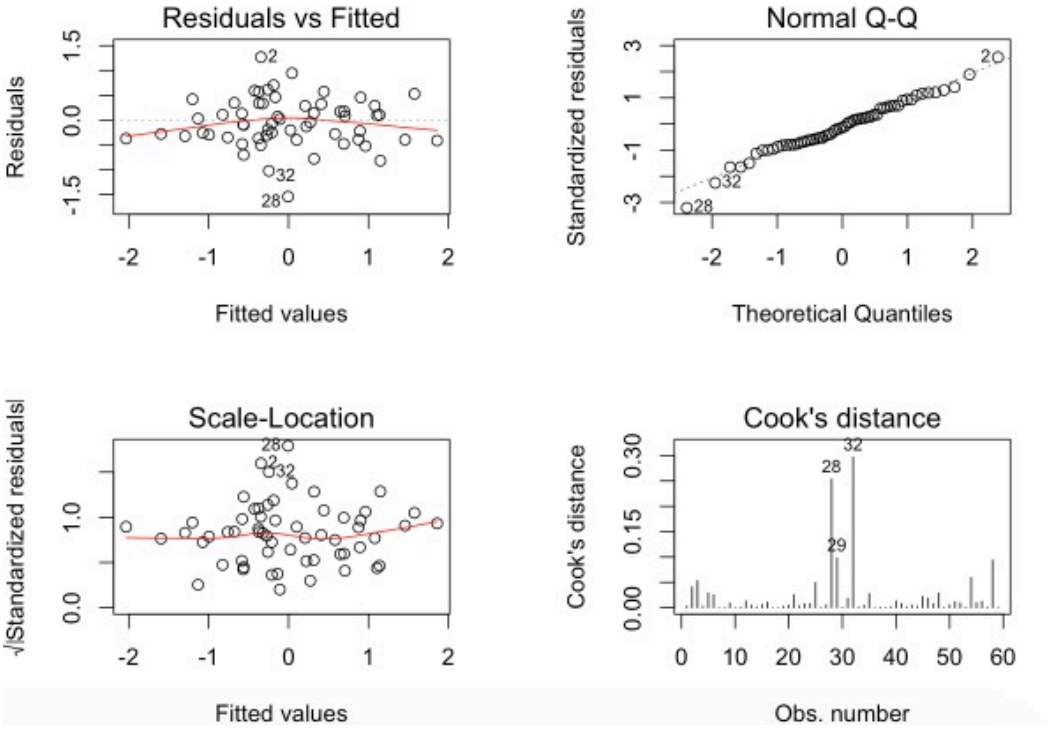


Table III.2.1 regression model of mortality to NOX and SO2

```
Call:
lm(formula = MORTALITY ~ NOX + SO2, data = mortality_std)

Residuals:
    Min      1Q  Median      3Q     Max
-1.8259 -0.5532  0.0329  0.4833  3.6518

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.488e-16  1.202e-01   0.000   1.0000
NOX         -7.380e-03  1.781e-01  -0.041   0.9671
SO2          4.085e-01  1.781e-01   2.293   0.0255 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.931 on 57 degrees of freedom
Multiple R-squared:  0.1625,    Adjusted R-squared:  0.1332
F-statistic: 5.531 on 2 and 57 DF,  p-value: 0.006375
```