3.1 Data summary

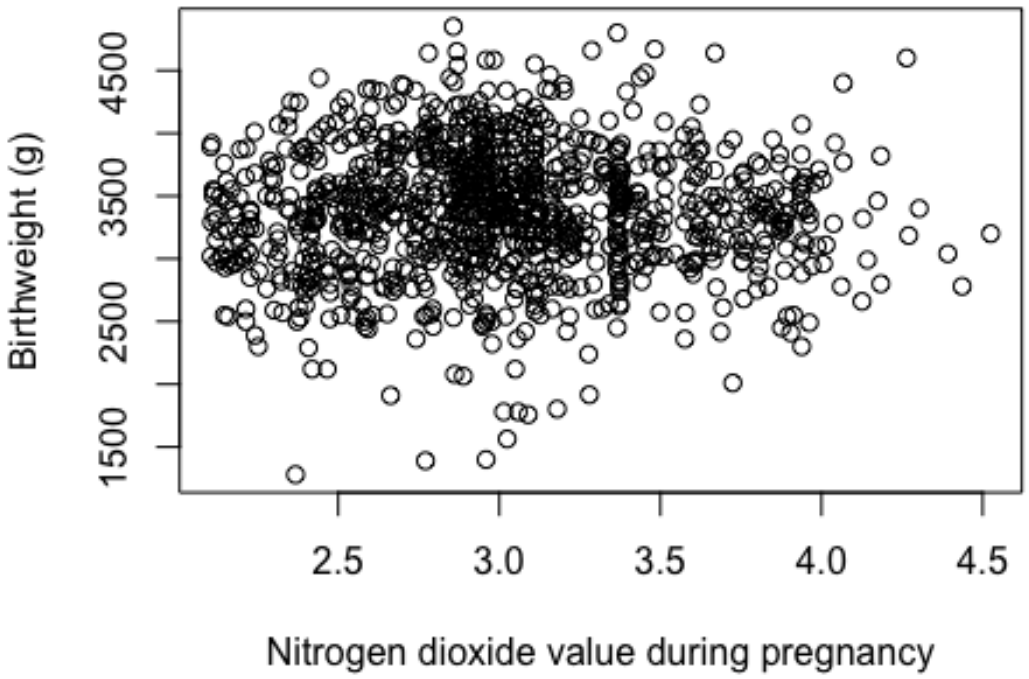
Appendix 1

```
dataset <- get(load("~/Desktop/Project/pollution.Rdata"))
data <- dataset[,c(1,3,4,5,28,69,70,74)]
data <- data.frame(data)
summary(data)
```

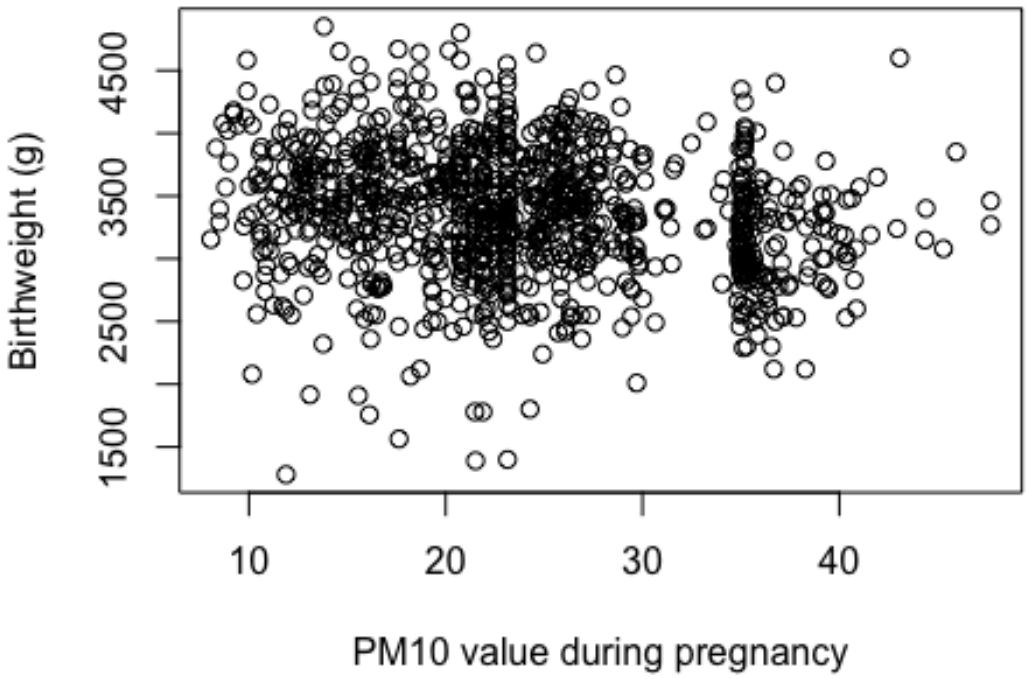
```
##      e3_bw      h_no2_ratio_preg_Log h_pm10_ratio_preg_None
##  Min.   :1280   Min.   :2.105        Min.   : 8.066
##  1st Qu.:3050   1st Qu.:2.663        1st Qu.:17.631
##  Median :3390   Median :2.967        Median :23.119
##  Mean   :3378   Mean   :3.009        Mean   :23.724
##  3rd Qu.:3720   3rd Qu.:3.340        3rd Qu.:27.885
##  Max.   :4850   Max.   :4.525        Max.   :47.698
##  h_pm25_ratio_preg_None h_humidity_preg_None e3_asmokcigd_p_None
##  Min.   : 6.957         Min.   :55.83        Min.   : 0.0000
##  1st Qu.:13.335         1st Qu.:70.44        1st Qu.: 0.0000
##  Median :14.905         Median :77.03        Median : 0.0000
##  Mean   :15.088         Mean   :76.48        Mean   : 0.5545
##  3rd Qu.:17.016         3rd Qu.:86.55        3rd Qu.: 0.0000
##  Max.   :22.238         Max.   :90.67        Max.   :15.2381
##  hs_cotinine_mcat_None e3_sex_None
##  Non-smokers:571       female:471
##  SHS smokers:129       male  :529
##  Smokers    :300
##
##
##
```

Appendix 2

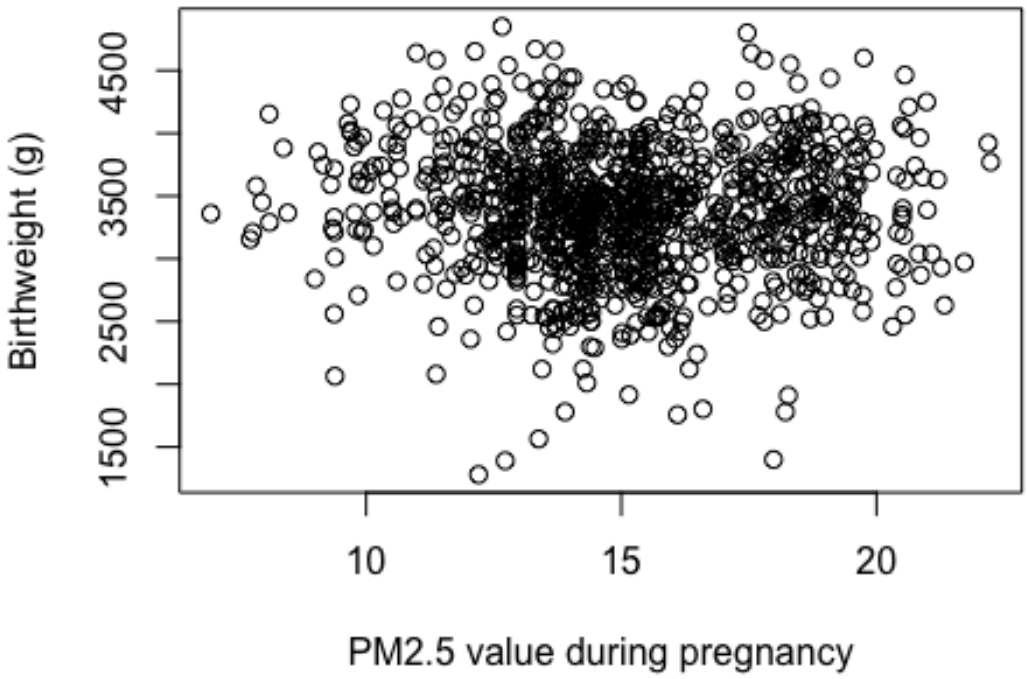
```
# scatter plots
plot(data$h_no2_ratio_preg_Log, data$e3_bw, ylab = "Birthweight (g)",
     xlab = "Nitrogen dioxide value during pregnancy")
```



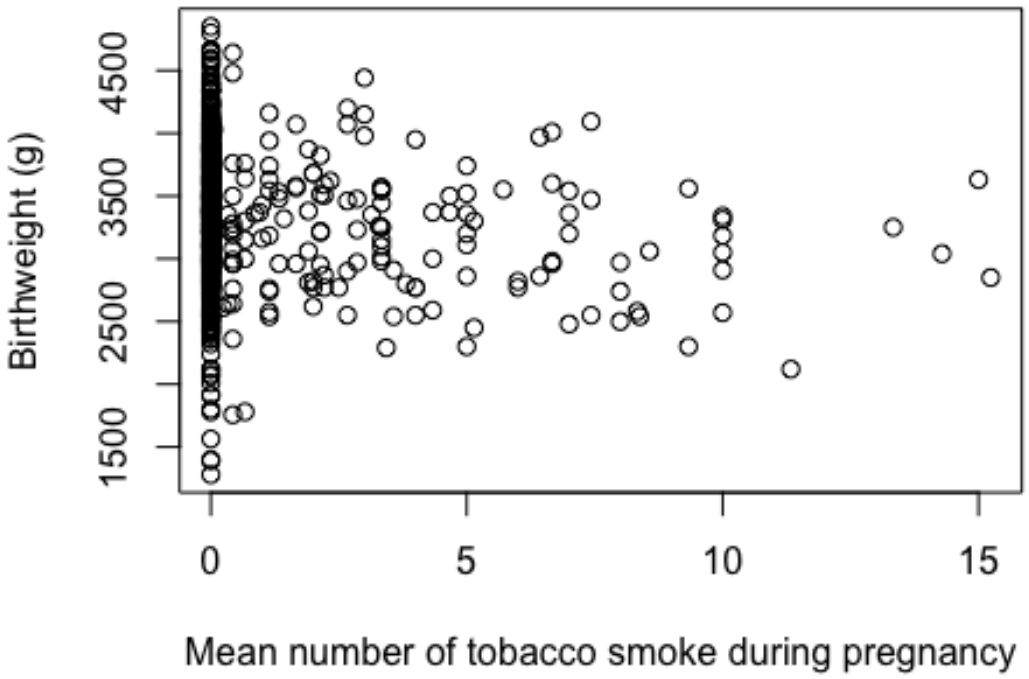

```r
plot(data$h_pm10_ratio_preg_None, data$e3_bw, ylab = "Birthweight (g)",
     xlab = "PM10 value during pregnancy")
```



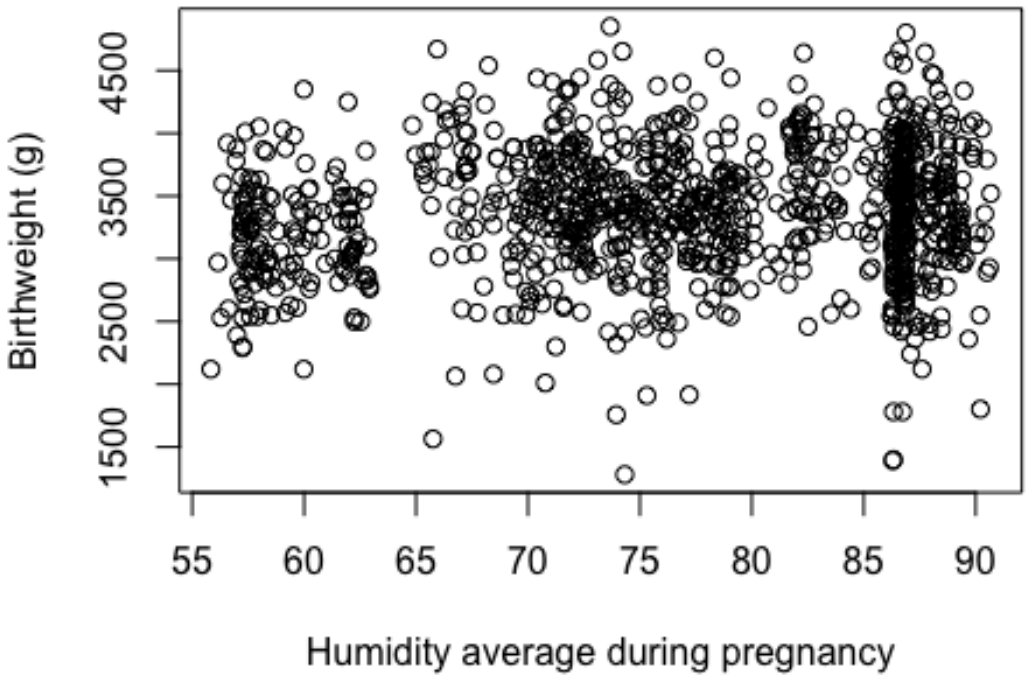

```r
plot(data$h_pm25_ratio_preg_None, data$e3_bw, ylab = "Birthweight (g)",
     xlab = "PM2.5 value during pregnancy")
```




```r
plot(data$e3_asmokcigd_p_None, data$e3_bw, ylab = "Birthweight (g)",
     xlab = "Mean number of tobacco smoke during pregnancy")
```




```r
plot(data$h_humidity_preg_None, data$e3_bw, ylab = "Birthweight (g)",
     xlab = "Humidity average during pregnancy")
```




```
cor(data$h_no2_ratio_preg_Log, data$e3_bw)
```

```
## [1] 0.005153035
```

```
cor(data$h_pm10_ratio_preg_None, data$e3_bw)
```

```
## [1] -0.1842447
```

```
cor(data$h_pm25_ratio_preg_None, data$e3_bw)
```

```
## [1] -0.02244666
```

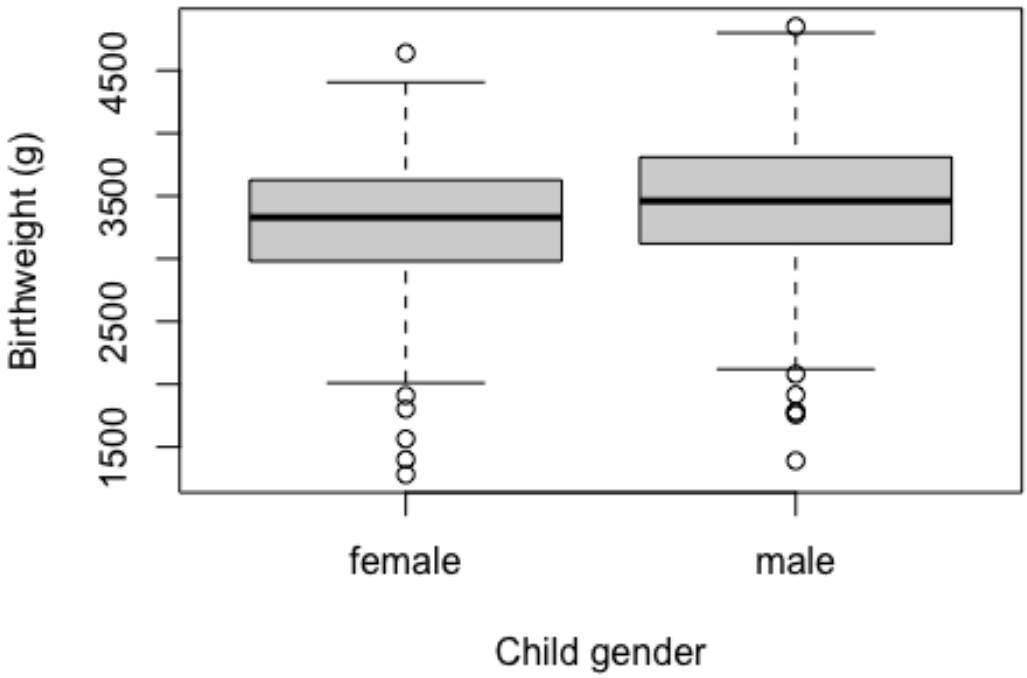
```
cor(data$h_humidity_preg_None, data$e3_bw)
```

```
## [1] 0.1004987
```

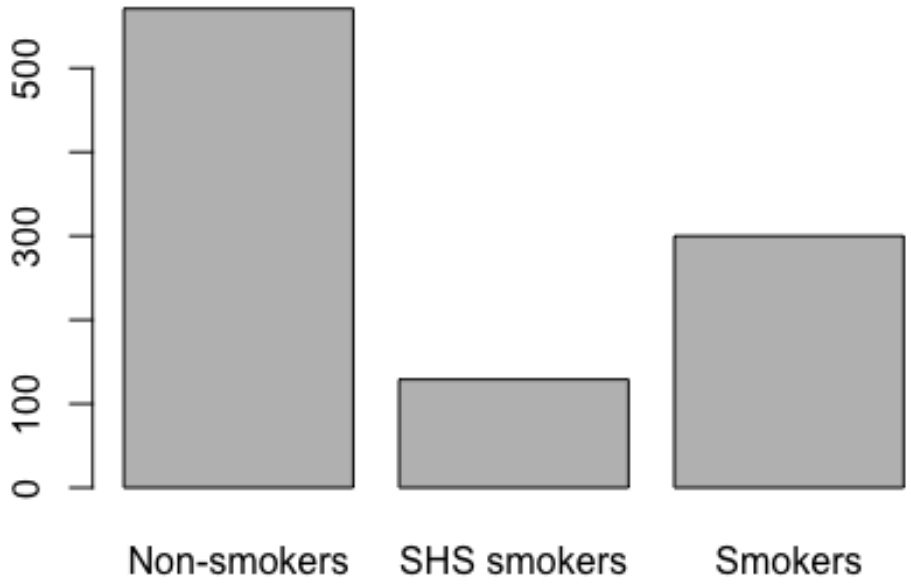
```
cor(data$e3_asmokcigd_p_None, data$e3_bw)
```

```
## [1] -0.1469302
```

```
plot(data$e3_sex_None, data$e3_bw, ylab = "Birthweight (g)",
     xlab = "Child gender")
```




```
barplot(summary(as.factor(data$hs_cotinine_mcat_None)))
```



Appendix 3

```
# convert the categorical variables to numeric
as.factor(data$e3_sex_None)
```

```
##    [1] female female male   male   female male   female male   male   male
##   [11] female female male   female male   female female male   female
female
##   [21] male   female female female male   female male   male   female
female
##   [31] female male   male   male   female female female male   female
female
##   [41] female male   male   male   male   female male   female male   male
##   [51] male   male   male   female male   male   male   female male   male
##   [61] male   female male   female male   female male   male   male
female
##   [71] female female male   female male   female male   male   male
female
##   [81] female female male   male   female female male   male   female male
##   [91] male   female male   female male   male   male   male   female male
##  [101] male   male   female male   female male   female female male   male
##  [111] male   male   female male   male   male   female male   female
```

```
female
##  [121] female female male   female female female female male   male   male
##  [131] male   female male   female male   female male   female male
female
##  [141] male   female male   female female female male   male   female
female
##  [151] male   male   male   female male   male   female male   female male
##  [161] female male   male   male   female male   female male   male   male
##  [171] male   male   female female male   male   female male   male
female
##  [181] female female female male   male   male   female female female male
##  [191] female male   female female male   female male   female male
female
##  [201] female female female female male   male   female female male   male
##  [211] male   male   male   male   male   female male   female male   male
##  [221] male   male   male   male   female male   male   male   male
female
##  [231] male   male   male   female male   male   male   female male
female
##  [241] female female female male   male   male   male   female female
female
##  [251] female male   female female male   male   male   male   female
female
##  [261] female female male   female male   male   female female female male
##  [271] male   female male   female female male   male   male   female male
##  [281] male   male   male   male   female female female male   female male
##  [291] male   female male   male   female female female female female
female
##  [301] male   male   male   male   female male   male   male   male
female
##  [311] male   female male   female female male   female female female male
##  [321] male   male   female male   male   female male   male   male
female
##  [331] male   male   male   male   female male   male   female female male
##  [341] male   female female female female female male   male   female
female
##  [351] female male   female female female female male   female male   male
##  [361] female male   female female male   male   female male   male
female
##  [371] female male   female female male   female female female male
female
##  [381] female male   female male   female male   female female male   male
##  [391] female female female female male   female male   male   male
female
##  [401] female female female male   male   female female male   male
female
##  [411] male   female male   female female female female male   male   male
##  [421] female female female male   female male   male   female female male
##  [431] male   male   male   female female male   male   female female male
##  [441] male   male   male   male   male   male   male   male   male   male
```

```
##  [451] female male   female male   female male   male   female male   male
##  [461] male   male   male   male   female male   female male   female
female
##  [471] female female male   female male   female male   female female male
##  [481] male   male   male   male   male   female male   male   male
female
##  [491] male   male   male   female male   female female male   male   male
##  [501] male   male   female female male   female female male   male   male
##  [511] male   female female male   female female female male   male
female
##  [521] female male   female male   female male   male   male   female male
##  [531] female male   male   female male   male   male   male   male
female
##  [541] male   female female female female male   female male   female
female
##  [551] male   female male   female female female female male   female
female
##  [561] female male   male   female female female male   male   male
female
##  [571] male   male   female female male   female male   male   male
female
##  [581] female male   female male   female female male   female male
female
##  [591] male   female female female female male   female male   female
female
##  [601] male   female female female male   male   female female female male
##  [611] male   female male   male   female male   female male   male   male
##  [621] female male   male   female male   female female female male
female
##  [631] male   female male   male   female male   female male   female
female
##  [641] female male   female male   male   female male   male   male
female
##  [651] male   female male   female male   female male   male   male   male
##  [661] female female female male   male   male   female female female
female
##  [671] male   male   female female male   female male   male   female male
##  [681] male   male   female female male   male   female male   female
female
##  [691] male   male   female male   female female male   female female male
##  [701] male   male   female female female female female female female
female
##  [711] male   female male   female male   female female male   male
female
##  [721] male   female female female male   male   female male   male
female
##  [731] male   female female male   male   female male   female male
female
##  [741] female male   male   female male   male   female male   female male
##  [751] male   male   female male   male   female male   male   female
```

```
female
##  [761] male   male   male   male   female male   male   male   male
female
##  [771] female male   male   male   female female female male   female male
##  [781] female male   male   female male   female male   male   male   male
##  [791] male   male   male   female female female male   female male
female
##  [801] male   female male   male   male   female female female male
female
##  [811] female male   female female female male   female male   female
female
##  [821] male   male   female female female male   male   male   female male
##  [831] female male   male   male   female male   male   female female male
##  [841] male   male   female male   male   male   male   male   female
female
##  [851] female female male   male   female male   male   female female
female
##  [861] male   female female male   female female male   female female
female
##  [871] female male   female female male   male   male   male   male   male
##  [881] female male   female female male   male   male   male   male   male
##  [891] male   female female male   female male   female female male
female
##  [901] female male   male   male   female female male   female male   male
##  [911] female male   male   male   female male   male   male   female
female
##  [921] female male   female female male   male   male   female female
female
##  [931] female female male   female female male   male   male   female
female
##  [941] male   male   male   female male   male   male   male   male   male
##  [951] female female male   female male   female male   male   female
female
##  [961] female male   female female female male   female male   male
female
##  [971] female female female female male   female male   male   male
female
##  [981] female female female male   female male   male   female female male
##  [991] female male   male   female male   male   female female male   male
## Levels: female male
```

```
as.factor(data$hs_cotinine_mcat_None)
```

```
##    [1] Smokers     Non-smokers Non-smokers Non-smokers Non-smokers Smokers
##    [7] Non-smokers SHS smokers Non-smokers Non-smokers Non-smokers SHS
smokers
##   [13] Non-smokers SHS smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##   [19] SHS smokers Non-smokers Non-smokers Non-smokers Non-smokers Smokers
##   [25] Smokers     Smokers     SHS smokers Smokers     Non-smokers
```

```
Non-smokers
##   [31] Non-smokers Smokers     Non-smokers Non-smokers Non-smokers
Non-smokers
##   [37] Non-smokers SHS smokers SHS smokers Non-smokers Smokers     SHS
smokers
##   [43] Non-smokers Smokers     Non-smokers Smokers     Smokers     SHS
smokers
##   [49] Smokers     Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##   [55] Non-smokers Non-smokers Non-smokers SHS smokers Non-smokers Smokers
##   [61] Smokers     Non-smokers Smokers     Non-smokers Non-smokers
Non-smokers
##   [67] Non-smokers Smokers     Non-smokers Smokers     Smokers
Non-smokers
##   [73] Smokers     Smokers     SHS smokers Non-smokers Non-smokers
Non-smokers
##   [79] Non-smokers Smokers     Smokers     Smokers     Non-smokers Smokers
##   [85] Non-smokers Non-smokers Non-smokers Smokers     Non-smokers
Non-smokers
##   [91] Non-smokers Smokers     Smokers     Smokers     Non-smokers Smokers
##   [97] Non-smokers Smokers     Non-smokers Non-smokers Non-smokers Smokers
##  [103] Smokers     Non-smokers Smokers     SHS smokers Smokers
Non-smokers
##  [109] Smokers     Non-smokers Non-smokers SHS smokers Non-smokers Smokers
##  [115] Non-smokers Non-smokers Non-smokers Smokers     Smokers     Smokers
##  [121] Non-smokers Non-smokers Non-smokers Smokers     Non-smokers
Non-smokers
##  [127] Non-smokers Smokers     Smokers     SHS smokers Non-smokers Smokers
##  [133] Non-smokers Non-smokers Non-smokers Smokers     Smokers
Non-smokers
##  [139] SHS smokers Non-smokers Smokers     Smokers     Non-smokers Smokers
##  [145] Smokers     Non-smokers Smokers     Non-smokers Non-smokers Smokers
##  [151] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers SHS
smokers
##  [157] Non-smokers Smokers     Smokers     SHS smokers Non-smokers Smokers
##  [163] Non-smokers SHS smokers Non-smokers Non-smokers Non-smokers SHS
smokers
##  [169] Non-smokers SHS smokers Non-smokers Smokers     Smokers     Smokers
##  [175] Non-smokers Smokers     Smokers     Non-smokers Smokers
Non-smokers
##  [181] Smokers     SHS smokers Non-smokers Smokers     Non-smokers
Non-smokers
##  [187] Non-smokers Non-smokers Non-smokers Smokers     Non-smokers
Non-smokers
##  [193] Smokers     SHS smokers Smokers     Smokers     Non-smokers
Non-smokers
##  [199] Non-smokers Non-smokers Non-smokers Non-smokers Smokers     SHS
smokers
##  [205] Smokers     Non-smokers Non-smokers Non-smokers Smokers
Non-smokers
```

```
##  [211] Smokers     Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##  [217] SHS smokers Non-smokers Smokers     Non-smokers Non-smokers
Non-smokers
##  [223] Smokers     Non-smokers Smokers     Smokers     Smokers     Smokers
##  [229] Smokers     Smokers     SHS smokers SHS smokers Smokers
Non-smokers
##  [235] SHS smokers SHS smokers Non-smokers Non-smokers SHS smokers
Non-smokers
##  [241] Non-smokers Non-smokers Non-smokers Non-smokers Smokers     Smokers
##  [247] Non-smokers SHS smokers Non-smokers Smokers     Non-smokers Smokers
##  [253] Non-smokers Non-smokers Smokers     Non-smokers Smokers     Smokers
##  [259] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers Smokers
##  [265] Non-smokers Non-smokers Smokers     Smokers     Smokers
Non-smokers
##  [271] Non-smokers SHS smokers Non-smokers Smokers     SHS smokers
Non-smokers
##  [277] SHS smokers Non-smokers Smokers     SHS smokers Smokers
Non-smokers
##  [283] SHS smokers Smokers     Smokers     Non-smokers Non-smokers SHS
smokers
##  [289] Non-smokers Non-smokers SHS smokers Smokers     Non-smokers Smokers
##  [295] Non-smokers SHS smokers Non-smokers Smokers     Non-smokers Smokers
##  [301] Smokers     Non-smokers Smokers     SHS smokers Non-smokers
Non-smokers
##  [307] Non-smokers SHS smokers Non-smokers SHS smokers Non-smokers Smokers
##  [313] Smokers     Non-smokers Smokers     Smokers     Smokers     SHS
smokers
##  [319] Non-smokers Non-smokers Smokers     Non-smokers SHS smokers
Non-smokers
##  [325] Non-smokers Smokers     Smokers     Smokers     Smokers     SHS
smokers
##  [331] SHS smokers Non-smokers Smokers     Smokers     SHS smokers Smokers
##  [337] Non-smokers Smokers     Non-smokers Non-smokers Non-smokers
Non-smokers
##  [343] Smokers     Non-smokers Non-smokers Smokers     Smokers     Smokers
##  [349] Non-smokers Smokers     SHS smokers Non-smokers Smokers
Non-smokers
##  [355] Non-smokers Non-smokers Smokers     Non-smokers Non-smokers Smokers
##  [361] Non-smokers Smokers     Smokers     Non-smokers Non-smokers SHS
smokers
##  [367] SHS smokers Non-smokers Non-smokers Non-smokers Smokers     SHS
smokers
##  [373] Smokers     Non-smokers Non-smokers SHS smokers Non-smokers
Non-smokers
##  [379] Non-smokers Smokers     Non-smokers Non-smokers Smokers
Non-smokers
##  [385] Smokers     SHS smokers Non-smokers Smokers     Smokers     Smokers
##  [391] Non-smokers Non-smokers Non-smokers SHS smokers Non-smokers Smokers
##  [397] Smokers     Non-smokers Non-smokers Non-smokers Non-smokers Smokers
```

```
##  [403] SHS smokers Smokers     Non-smokers Smokers     Non-smokers SHS
smokers
##  [409] SHS smokers Non-smokers Smokers     Smokers     Smokers
Non-smokers
##  [415] Non-smokers Smokers     Non-smokers Non-smokers Smokers     Smokers
##  [421] Non-smokers Smokers     Non-smokers SHS smokers SHS smokers SHS
smokers
##  [427] Non-smokers Smokers     Non-smokers Smokers     Smokers
Non-smokers
##  [433] Non-smokers Non-smokers Smokers     Smokers     Non-smokers SHS
smokers
##  [439] Non-smokers SHS smokers SHS smokers Smokers     SHS smokers
Non-smokers
##  [445] SHS smokers Smokers     SHS smokers Non-smokers Smokers     Smokers
##  [451] Non-smokers Smokers     Non-smokers Smokers     Smokers     SHS
smokers
##  [457] SHS smokers Non-smokers Smokers     Non-smokers Non-smokers
Non-smokers
##  [463] Non-smokers Smokers     Non-smokers Non-smokers Smokers
Non-smokers
##  [469] Smokers     Smokers     SHS smokers Non-smokers Non-smokers
Non-smokers
##  [475] Non-smokers Non-smokers Smokers     Smokers     Non-smokers Smokers
##  [481] Non-smokers Smokers     Non-smokers Smokers     Non-smokers
Non-smokers
##  [487] Non-smokers Non-smokers Smokers     Smokers     Non-smokers Smokers
##  [493] Smokers     Non-smokers Non-smokers Smokers     Non-smokers
Non-smokers
##  [499] Non-smokers Smokers     Non-smokers Smokers     Non-smokers
Non-smokers
##  [505] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##  [511] Non-smokers Non-smokers Smokers     Non-smokers Non-smokers
Non-smokers
##  [517] Smokers     Smokers     Non-smokers Smokers     Non-smokers Smokers
##  [523] Smokers     Non-smokers Non-smokers Smokers     Smokers     Smokers
##  [529] Non-smokers Smokers     Non-smokers Non-smokers Non-smokers Smokers
##  [535] Non-smokers Smokers     Non-smokers Non-smokers Non-smokers
Non-smokers
##  [541] Non-smokers Smokers     Non-smokers Non-smokers Non-smokers SHS
smokers
##  [547] Smokers     Non-smokers Smokers     Non-smokers Non-smokers
Non-smokers
##  [553] Non-smokers Non-smokers Non-smokers Smokers     SHS smokers Smokers
##  [559] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##  [565] Smokers     Smokers     Non-smokers Non-smokers Smokers     SHS
smokers
##  [571] SHS smokers SHS smokers Non-smokers Non-smokers Non-smokers Smokers
##  [577] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers
```

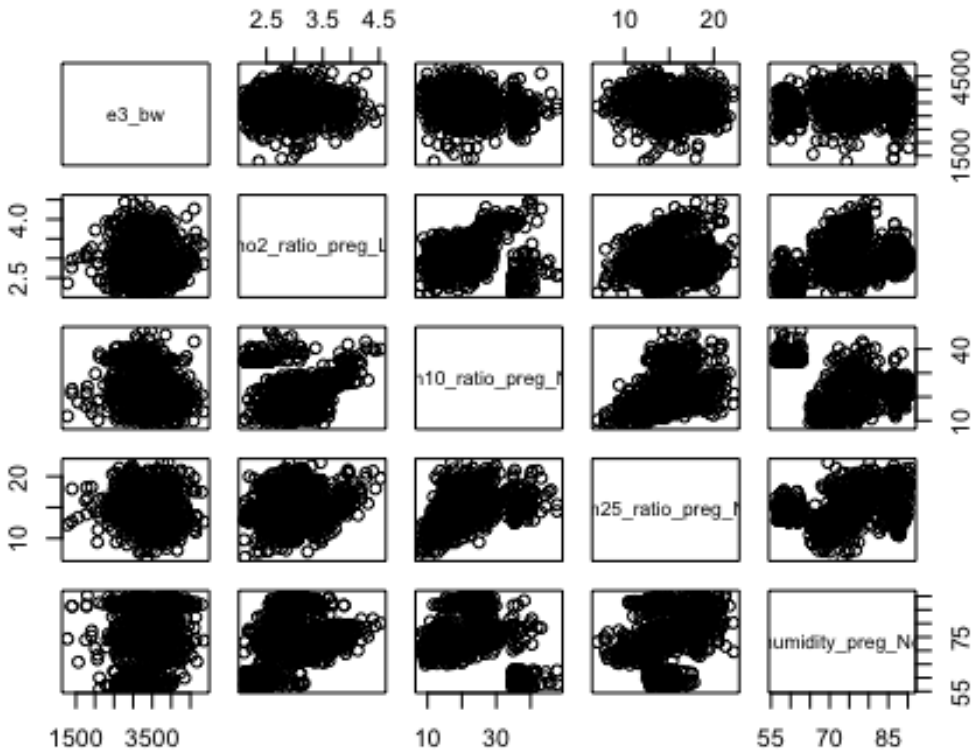
```
Non-smokers
##  [583] Smokers     Smokers     SHS smokers SHS smokers Non-smokers SHS
smokers
##  [589] Non-smokers Non-smokers Non-smokers Smokers     Smokers
Non-smokers
##  [595] Non-smokers Non-smokers Smokers     Non-smokers Smokers
Non-smokers
##  [601] Non-smokers SHS smokers Smokers     Smokers     Smokers
Non-smokers
##  [607] Smokers     Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##  [613] SHS smokers SHS smokers Non-smokers Non-smokers Smokers     Smokers
##  [619] Non-smokers Non-smokers Smokers     Smokers     Non-smokers
Non-smokers
##  [625] Non-smokers Smokers     Non-smokers SHS smokers Non-smokers
Non-smokers
##  [631] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##  [637] Smokers     Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##  [643] Non-smokers Smokers     Non-smokers Non-smokers SHS smokers
Non-smokers
##  [649] Non-smokers Smokers     SHS smokers Smokers     Non-smokers
Non-smokers
##  [655] Non-smokers Smokers     Non-smokers Non-smokers Non-smokers
Non-smokers
##  [661] Non-smokers Non-smokers Smokers     Smokers     Non-smokers
Non-smokers
##  [667] Non-smokers Non-smokers Smokers     Non-smokers SHS smokers Smokers
##  [673] Non-smokers Non-smokers Non-smokers SHS smokers Non-smokers SHS
smokers
##  [679] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers SHS
smokers
##  [685] Non-smokers Non-smokers SHS smokers Smokers     Non-smokers Smokers
##  [691] Smokers     Non-smokers Smokers     Smokers     Non-smokers SHS
smokers
##  [697] Non-smokers Non-smokers SHS smokers Non-smokers Smokers     Smokers
##  [703] Non-smokers SHS smokers Non-smokers Non-smokers Smokers
Non-smokers
##  [709] Non-smokers Smokers     Non-smokers Non-smokers Smokers
Non-smokers
##  [715] Non-smokers Non-smokers Non-smokers Smokers     Smokers
Non-smokers
##  [721] SHS smokers Non-smokers SHS smokers Non-smokers Non-smokers
Non-smokers
##  [727] Smokers     Smokers     Non-smokers SHS smokers SHS smokers
Non-smokers
##  [733] SHS smokers Non-smokers Non-smokers Non-smokers Smokers
Non-smokers
##  [739] Non-smokers Smokers     SHS smokers SHS smokers Non-smokers
```

```
Non-smokers
##  [745] Non-smokers Smokers     Smokers     Non-smokers Non-smokers
Non-smokers
##  [751] SHS smokers Non-smokers Non-smokers Non-smokers SHS smokers SHS
smokers
##  [757] Non-smokers Non-smokers Non-smokers Smokers     Non-smokers
Non-smokers
##  [763] Non-smokers SHS smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##  [769] Non-smokers Non-smokers SHS smokers Smokers     Smokers
Non-smokers
##  [775] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##  [781] Smokers     Non-smokers Non-smokers Non-smokers Non-smokers Smokers
##  [787] Non-smokers Non-smokers SHS smokers Non-smokers Smokers
Non-smokers
##  [793] Smokers     Non-smokers Non-smokers Non-smokers SHS smokers
Non-smokers
##  [799] Non-smokers Non-smokers Non-smokers SHS smokers SHS smokers
Non-smokers
##  [805] Non-smokers Smokers     Non-smokers Non-smokers Non-smokers
Non-smokers
##  [811] Non-smokers Smokers     Smokers     Non-smokers Non-smokers
Non-smokers
##  [817] Non-smokers SHS smokers Smokers     Non-smokers Non-smokers
Non-smokers
##  [823] Non-smokers Non-smokers Smokers     Non-smokers Non-smokers
Non-smokers
##  [829] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers Smokers
##  [835] Non-smokers Smokers     Non-smokers Non-smokers Smokers     Smokers
##  [841] Non-smokers Smokers     Non-smokers Smokers     SHS smokers
Non-smokers
##  [847] Non-smokers Smokers     Smokers     SHS smokers Non-smokers Smokers
##  [853] Non-smokers SHS smokers Smokers     Non-smokers Smokers
Non-smokers
##  [859] Non-smokers Non-smokers SHS smokers Smokers     Smokers
Non-smokers
##  [865] Non-smokers Non-smokers Smokers     Smokers     SHS smokers
Non-smokers
##  [871] Non-smokers Non-smokers SHS smokers Non-smokers Non-smokers
Non-smokers
##  [877] Non-smokers SHS smokers Non-smokers Non-smokers SHS smokers SHS
smokers
##  [883] Smokers     Non-smokers Non-smokers Smokers     Non-smokers
Non-smokers
##  [889] Smokers     Non-smokers Non-smokers Non-smokers Smokers
Non-smokers
##  [895] Smokers     Non-smokers Non-smokers Smokers     Smokers     Smokers
##  [901] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
```

```
##  [907] Smokers     Non-smokers SHS smokers Smokers     Non-smokers Smokers
##  [913] Smokers     Smokers     Non-smokers SHS smokers Non-smokers
Non-smokers
##  [919] Smokers     Smokers     Non-smokers Non-smokers SHS smokers
Non-smokers
##  [925] Non-smokers Smokers     Non-smokers Non-smokers Smokers     SHS
smokers
##  [931] Non-smokers Non-smokers Non-smokers Smokers     Non-smokers
Non-smokers
##  [937] Non-smokers SHS smokers SHS smokers Non-smokers Non-smokers
Non-smokers
##  [943] Non-smokers SHS smokers Non-smokers Smokers     SHS smokers Smokers
##  [949] Non-smokers Non-smokers Non-smokers Smokers     Non-smokers
Non-smokers
##  [955] Non-smokers Non-smokers Non-smokers SHS smokers Non-smokers
Non-smokers
##  [961] SHS smokers Non-smokers Non-smokers Non-smokers Non-smokers
Non-smokers
##  [967] Non-smokers Non-smokers Smokers     Smokers     Non-smokers Smokers
##  [973] Non-smokers Smokers     Smokers     SHS smokers Non-smokers SHS
smokers
##  [979] Non-smokers Non-smokers Non-smokers Non-smokers Non-smokers Smokers
##  [985] Smokers     Smokers     Non-smokers Non-smokers Smokers     Smokers
##  [991] SHS smokers Non-smokers Non-smokers Smokers     Non-smokers Smokers
##  [997] Smokers     Smokers     Smokers     Non-smokers
## Levels: Non-smokers SHS smokers Smokers
```

Appendix 4

```
pairs(~ e3_bw + h_no2_ratio_preg_Log + h_pm10_ratio_preg_None +
h_pm25_ratio_preg_None + h_humidity_preg_None, data = data)
```



Appendix 5

```
# minimal model
M0 <- lm(e3_bw ~ 1, data = data)
summary(M0)

##
## Call:
## lm(formula = e3_bw ~ 1, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2098.48  -328.48    11.52   341.52  1471.52
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   3378.5       16.1   209.8   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 509.2 on 999 degrees of freedom
```

Appendix 6

```
# full model
Mfull <- lm(e3_bw ~ as.factor(e3_sex_None) * (h_humidity_preg_None +
                                                h_no2_ratio_preg_Log +
                                                h_pm10_ratio_preg_None +
                                                h_pm25_ratio_preg_None) +
              e3_asmokcigd_p_None +
              as.factor(hs_cotinine_mcat_None), data = data)
summary(Mfull)
```

```
##
## Call:
## lm(formula = e3_bw ~ as.factor(e3_sex_None) * (h_humidity_preg_None +
##     h_no2_ratio_preg_Log + h_pm10_ratio_preg_None +
h_pm25_ratio_preg_None) +
##     e3_asmokcigd_p_None + as.factor(hs_cotinine_mcat_None), data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2131.69  -287.98    15.25   312.99  1315.03
##
## Coefficients:
##                                                  Estimate Std. Error t
value
## (Intercept)                                    3565.45121  241.27167
14.778
## as.factor(e3_sex_None)male                       40.18978  328.99865
0.122
## h_humidity_preg_None                             -1.29133    3.12607
-0.413
## h_no2_ratio_preg_Log                             51.96849   52.01320
0.999
## h_pm10_ratio_preg_None                          -11.60422    3.58713
-3.235
## h_pm25_ratio_preg_None                           -3.50976   10.80055
-0.325
## e3_asmokcigd_p_None                             -37.43169    8.84152
-4.234
## as.factor(hs_cotinine_mcat_None)SHS smokers       10.10250   50.35963
0.201
## as.factor(hs_cotinine_mcat_None)Smokers           90.83369   40.28275
2.255
## as.factor(e3_sex_None)male:h_humidity_preg_None    1.45428    4.17573
0.348
## as.factor(e3_sex_None)male:h_no2_ratio_preg_Log  -58.11887   70.39293
-0.826
```

```
## as.factor(e3_sex_None)male:h_pm10_ratio_preg_None    0.04814    4.80346
0.010
## as.factor(e3_sex_None)male:h_pm25_ratio_preg_None   10.97259   14.20123
0.773
##                                                    Pr(>|t|)
## (Intercept)                                         < 2e-16 ***
## as.factor(e3_sex_None)male                          0.90280
## h_humidity_preg_None                                0.67963
## h_no2_ratio_preg_Log                                0.31797
## h_pm10_ratio_preg_None                              0.00126 **
## h_pm25_ratio_preg_None                              0.74528
## e3_asmokcigd_p_None                                2.51e-05 ***
## as.factor(hs_cotinine_mcat_None)SHS smokers         0.84105
## as.factor(hs_cotinine_mcat_None)Smokers             0.02436 *
## as.factor(e3_sex_None)male:h_humidity_preg_None     0.72771
## as.factor(e3_sex_None)male:h_no2_ratio_preg_Log     0.40921
## as.factor(e3_sex_None)male:h_pm10_ratio_preg_None   0.99201
## as.factor(e3_sex_None)male:h_pm25_ratio_preg_None   0.43991
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 492.8 on 987 degrees of freedom
## Multiple R-squared:  0.07475,    Adjusted R-squared:  0.0635
## F-statistic: 6.645 on 12 and 987 DF,  p-value: 1.492e-11
```

Appendix 7

```
# backward selection
system.time({
  Mback <- step(object = Mfull,
                scope = list(lower = M0, upper = Mfull),
                trace = 1,
                direction = "backward")
})
```

```
## Start:  AIC=12413.11
## e3_bw ~ as.factor(e3_sex_None) * (h_humidity_preg_None +
h_no2_ratio_preg_Log +
##     h_pm10_ratio_preg_None + h_pm25_ratio_preg_None) + e3_asmokcigd_p_None
+
##     as.factor(hs_cotinine_mcat_None)
##
##                                                  Df Sum of Sq       RSS
AIC
## - as.factor(e3_sex_None):h_pm10_ratio_preg_None  1        24 239693156
12411
## - as.factor(e3_sex_None):h_humidity_preg_None    1     29456 239722588
12411
## - as.factor(e3_sex_None):h_pm25_ratio_preg_None  1    144979 239838111
12412
```

```
## - as.factor(e3_sex_None):h_no2_ratio_preg_Log    1    165545 239858677
12412
## <none>                                                    239693132
12413
## - as.factor(hs_cotinine_mcat_None)               2   1291350 240984482
12414
## - e3_asmokcigd_p_None                            1   4352751 244045883
12429
##
## Step:  AIC=12411.11
## e3_bw ~ as.factor(e3_sex_None) + h_humidity_preg_None +
h_no2_ratio_preg_Log +
##     h_pm10_ratio_preg_None + h_pm25_ratio_preg_None + e3_asmokcigd_p_None
+
##     as.factor(hs_cotinine_mcat_None) +
as.factor(e3_sex_None):h_humidity_preg_None +
##     as.factor(e3_sex_None):h_no2_ratio_preg_Log +
as.factor(e3_sex_None):h_pm25_ratio_preg_None
##
##                                                 Df Sum of Sq       RSS
AIC
## - as.factor(e3_sex_None):h_humidity_preg_None    1     39710 239732866
12409
## - as.factor(e3_sex_None):h_no2_ratio_preg_Log    1    166921 239860078
12410
## - as.factor(e3_sex_None):h_pm25_ratio_preg_None  1    188858 239882015
12410
## <none>                                                    239693156
12411
## - as.factor(hs_cotinine_mcat_None)               2   1291348 240984505
12412
## - e3_asmokcigd_p_None                            1   4352744 244045901
12427
## - h_pm10_ratio_preg_None                         1   5053817 244746973
12430
##
## Step:  AIC=12409.28
## e3_bw ~ as.factor(e3_sex_None) + h_humidity_preg_None +
h_no2_ratio_preg_Log +
##     h_pm10_ratio_preg_None + h_pm25_ratio_preg_None + e3_asmokcigd_p_None
+
##     as.factor(hs_cotinine_mcat_None) +
as.factor(e3_sex_None):h_no2_ratio_preg_Log +
##     as.factor(e3_sex_None):h_pm25_ratio_preg_None
##
##                                                 Df Sum of Sq       RSS
AIC
## - h_humidity_preg_None                           1     13523 239746389
12407
## - as.factor(e3_sex_None):h_no2_ratio_preg_Log    1    133482 239866348
```

```
12408
## - as.factor(e3_sex_None):h_pm25_ratio_preg_None  1    270351 240003217
12408
## <none>                                                       239732866
12409
## - as.factor(hs_cotinine_mcat_None)               2   1307026 241039893
12411
## - e3_asmokcigd_p_None                            1   4326681 244059547
12425
## - h_pm10_ratio_preg_None                         1   5043318 244776184
12428
##
## Step:  AIC=12407.34
## e3_bw ~ as.factor(e3_sex_None) + h_no2_ratio_preg_Log +
h_pm10_ratio_preg_None +
##     h_pm25_ratio_preg_None + e3_asmokcigd_p_None +
as.factor(hs_cotinine_mcat_None) +
##     as.factor(e3_sex_None):h_no2_ratio_preg_Log +
as.factor(e3_sex_None):h_pm25_ratio_preg_None
##
##                                                 Df Sum of Sq       RSS
AIC
## - as.factor(e3_sex_None):h_no2_ratio_preg_Log    1    134715 239881105
12406
## - as.factor(e3_sex_None):h_pm25_ratio_preg_None  1    274974 240021364
12406
## <none>                                                       239746389
12407
## - as.factor(hs_cotinine_mcat_None)               2   1332133 241078523
12409
## - e3_asmokcigd_p_None                            1   4322869 244069258
12423
## - h_pm10_ratio_preg_None                         1   6708183 246454573
12433
##
## Step:  AIC=12405.9
## e3_bw ~ as.factor(e3_sex_None) + h_no2_ratio_preg_Log +
h_pm10_ratio_preg_None +
##     h_pm25_ratio_preg_None + e3_asmokcigd_p_None +
as.factor(hs_cotinine_mcat_None) +
##     as.factor(e3_sex_None):h_pm25_ratio_preg_None
##
##                                                 Df Sum of Sq       RSS
AIC
## - h_no2_ratio_preg_Log                           1     67017 239948122
12404
## - as.factor(e3_sex_None):h_pm25_ratio_preg_None  1    216130 240097235
12405
## <none>                                                       239881105
12406
```

```
## - as.factor(hs_cotinine_mcat_None)               2   1304140 241185245
12407
## - e3_asmokcigd_p_None                            1   4358871 244239976
12422
## - h_pm10_ratio_preg_None                         1   6818839 246699944
12432
##
## Step:  AIC=12404.18
## e3_bw ~ as.factor(e3_sex_None) + h_pm10_ratio_preg_None +
h_pm25_ratio_preg_None +
##     e3_asmokcigd_p_None + as.factor(hs_cotinine_mcat_None) +
##     as.factor(e3_sex_None):h_pm25_ratio_preg_None
##
##                                                Df Sum of Sq       RSS
AIC
## - as.factor(e3_sex_None):h_pm25_ratio_preg_None  1    208685 240156807
12403
## <none>                                                      239948122
12404
## - as.factor(hs_cotinine_mcat_None)               2   1245721 241193843
12405
## - e3_asmokcigd_p_None                            1   4292934 244241056
12420
## - h_pm10_ratio_preg_None                         1   6869665 246817787
12430
##
## Step:  AIC=12403.05
## e3_bw ~ as.factor(e3_sex_None) + h_pm10_ratio_preg_None +
h_pm25_ratio_preg_None +
##     e3_asmokcigd_p_None + as.factor(hs_cotinine_mcat_None)
##
##                                    Df Sum of Sq       RSS   AIC
## - h_pm25_ratio_preg_None            1     44003 240200810 12401
## <none>                                          240156807 12403
## - as.factor(hs_cotinine_mcat_None)  2   1194677 241351485 12404
## - e3_asmokcigd_p_None               1   4254216 244411023 12419
## - as.factor(e3_sex_None)            1   5083034 245239842 12422
## - h_pm10_ratio_preg_None            1   6905127 247061934 12429
##
## Step:  AIC=12401.23
## e3_bw ~ as.factor(e3_sex_None) + h_pm10_ratio_preg_None +
e3_asmokcigd_p_None +
##     as.factor(hs_cotinine_mcat_None)
##
##                                    Df Sum of Sq       RSS   AIC
## <none>                                          240200810 12401
## - as.factor(hs_cotinine_mcat_None)  2   1429553 241630363 12403
## - e3_asmokcigd_p_None               1   4282393 244483203 12417
## - as.factor(e3_sex_None)            1   5089006 245289817 12420
## - h_pm10_ratio_preg_None            1   7045288 247246098 12428
```

```
##    user  system elapsed
##   0.044   0.002   0.046
```

Appendix 8

```
# stepwise selection
system.time({
  Mstep <- step(object = M0,
                scope = list(lower = M0, upper = Mfull),
                trace = 1,
                direction = "both")
})
```

```
## Start:  AIC=12466.81
## e3_bw ~ 1
##
##                                    Df Sum of Sq       RSS   AIC
## + h_pm10_ratio_preg_None            1   8793991 250263548 12434
## + e3_asmokcigd_p_None               1   5592658 253464881 12447
## + as.factor(e3_sex_None)            1   5308973 253748566 12448
## + h_humidity_preg_None              1   2616477 256441062 12459
## <none>                                          259057540 12467
## + h_pm25_ratio_preg_None            1    130527 258927013 12468
## + as.factor(hs_cotinine_mcat_None)  2    599775 258457764 12468
## + h_no2_ratio_preg_Log              1      6879 259050661 12469
##
## Step:  AIC=12434.27
## e3_bw ~ h_pm10_ratio_preg_None
##
##                                    Df Sum of Sq       RSS   AIC
## + as.factor(e3_sex_None)            1   4987554 245275994 12416
## + e3_asmokcigd_p_None               1   3599179 246664369 12422
## <none>                                          250263548 12434
## + h_humidity_preg_None              1    294013 249969535 12435
## + h_pm25_ratio_preg_None            1    255450 250008098 12435
## + as.factor(hs_cotinine_mcat_None)  2    753021 249510528 12435
## + h_no2_ratio_preg_Log              1      1560 250261988 12436
## - h_pm10_ratio_preg_None            1   8793991 259057540 12467
##
## Step:  AIC=12416.14
## e3_bw ~ h_pm10_ratio_preg_None + as.factor(e3_sex_None)
##
##                                           Df Sum of Sq       RSS
AIC
## + e3_asmokcigd_p_None                      1   3645630 241630363
12403
## <none>                                                 245275994
12416
## + as.factor(hs_cotinine_mcat_None)         2    792791 244483203
12417
```

```
## + h_pm25_ratio_preg_None                             1    251946 245024047
12417
## + h_humidity_preg_None                               1    208459 245067534
12417
## + as.factor(e3_sex_None):h_pm10_ratio_preg_None  1      3162 245272831
12418
## + h_no2_ratio_preg_Log                               1       372 245275621
12418
## - as.factor(e3_sex_None)                             1   4987554 250263548
12434
## - h_pm10_ratio_preg_None                             1   8472573 253748566
12448
##
## Step:  AIC=12403.16
## e3_bw ~ h_pm10_ratio_preg_None + as.factor(e3_sex_None) +
e3_asmokcigd_p_None
##
##                                                 Df Sum of Sq       RSS
AIC
## + as.factor(hs_cotinine_mcat_None)               2   1429553 240200810
12401
## <none>                                                       241630363
12403
## + h_pm25_ratio_preg_None                             1    278879 241351485
12404
## + h_humidity_preg_None                               1    181753 241448610
12404
## + h_no2_ratio_preg_Log                               1     32698 241597666
12405
## + as.factor(e3_sex_None):h_pm10_ratio_preg_None  1       592 241629771
12405
## - e3_asmokcigd_p_None                                1   3645630 245275994
12416
## - as.factor(e3_sex_None)                             1   5034006 246664369
12422
## - h_pm10_ratio_preg_None                             1   6510749 248141113
12428
##
## Step:  AIC=12401.23
## e3_bw ~ h_pm10_ratio_preg_None + as.factor(e3_sex_None) +
e3_asmokcigd_p_None +
##     as.factor(hs_cotinine_mcat_None)
##
##                                                 Df Sum of Sq       RSS
AIC
## <none>                                                       240200810
12401
## + h_no2_ratio_preg_Log                               1     80614 240120196
12403
## + h_pm25_ratio_preg_None                             1     44003 240156807
```

```
12403
## - as.factor(hs_cotinine_mcat_None)               2   1429553 241630363
12403
## + as.factor(e3_sex_None):h_pm10_ratio_preg_None  1      6230 240194580
12403
## + h_humidity_preg_None                           1      3531 240197279
12403
## - e3_asmokcigd_p_None                            1   4282393 244483203
12417
## - as.factor(e3_sex_None)                         1   5089006 245289817
12420
## - h_pm10_ratio_preg_None                         1   7045288 247246098
12428

##    user  system elapsed
##   0.032   0.001   0.033
```

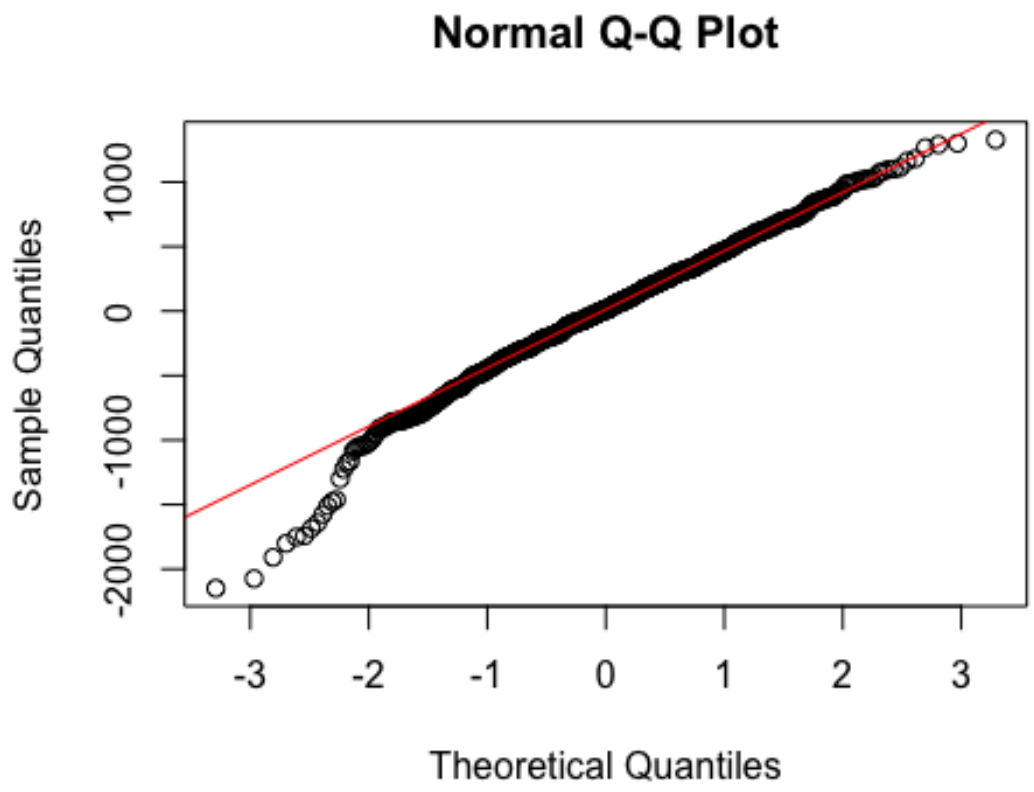
Appendix 9

```
final.model <- lm(e3_bw ~ as.factor(e3_sex_None) + h_pm10_ratio_preg_None +
                    e3_asmokcigd_p_None + as.factor(hs_cotinine_mcat_None),
data = data)
summary(final.model)

##
## Call:
## lm(formula = e3_bw ~ as.factor(e3_sex_None) + h_pm10_ratio_preg_None +
##     e3_asmokcigd_p_None + as.factor(hs_cotinine_mcat_None), data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2148.53  -292.54    11.73   319.50  1327.39
##
## Coefficients:
##                                             Estimate Std. Error t value
## (Intercept)                                 3561.362     51.744  68.827
## as.factor(e3_sex_None)male                   143.015     31.164   4.589
## h_pm10_ratio_preg_None                       -11.170      2.069  -5.400
## e3_asmokcigd_p_None                          -36.652      8.707  -4.210
## as.factor(hs_cotinine_mcat_None)SHS smokers    5.924     49.704   0.119
## as.factor(hs_cotinine_mcat_None)Smokers       86.730     36.923   2.349
##                                            Pr(>|t|)
## (Intercept)                                 < 2e-16 ***
## as.factor(e3_sex_None)male                 5.02e-06 ***
## h_pm10_ratio_preg_None                     8.36e-08 ***
## e3_asmokcigd_p_None                        2.79e-05 ***
## as.factor(hs_cotinine_mcat_None)SHS smokers    0.905
## as.factor(hs_cotinine_mcat_None)Smokers        0.019 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 491.6 on 994 degrees of freedom
## Multiple R-squared:  0.07279,    Adjusted R-squared:  0.06813
## F-statistic: 15.61 on 5 and 994 DF,  p-value: 8.313e-15
```

Appendix 10

```
qqnorm(residuals(final.model))
qqline(residuals(final.model), col = "red")
```



Appendix 11

```
# female model
female.data <- data[data$e3_sex_None == "female",]
female.final.model <- lm(e3_bw ~ h_pm10_ratio_preg_None + e3_asmokcigd_p_None
+
                           as.factor(hs_cotinine_mcat_None), data =
female.data)
summary(female.final.model)

##
## Call:
```

```
## lm(formula = e3_bw ~ h_pm10_ratio_preg_None + e3_asmokcigd_p_None +
##     as.factor(hs_cotinine_mcat_None), data = female.data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2154.85  -276.77    10.97   312.91  1249.87
##
## Coefficients:
##                                            Estimate Std. Error t value
## (Intercept)                                3565.483     67.736  52.638
## h_pm10_ratio_preg_None                      -10.985      2.876  -3.820
## e3_asmokcigd_p_None                         -40.590     12.371  -3.281
## as.factor(hs_cotinine_mcat_None)SHS smokers  -67.226     70.896  -0.948
## as.factor(hs_cotinine_mcat_None)Smokers       94.785     52.057   1.821
##                                            Pr(>|t|)
## (Intercept)                                 < 2e-16 ***
## h_pm10_ratio_preg_None                     0.000152 ***
## e3_asmokcigd_p_None                        0.001112 **
## as.factor(hs_cotinine_mcat_None)SHS smokers 0.343504
## as.factor(hs_cotinine_mcat_None)Smokers     0.069277 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 472.1 on 466 degrees of freedom
## Multiple R-squared:  0.06731,    Adjusted R-squared:  0.05931
## F-statistic: 8.408 on 4 and 466 DF,  p-value: 1.482e-06
```

```
# male model
male.data <- data[data$e3_sex_None == "male",]
male.final.model <- lm(e3_bw ~ h_pm10_ratio_preg_None + e3_asmokcigd_p_None +
                         as.factor(hs_cotinine_mcat_None), data =
male.data)
summary(male.final.model)
```

```
##
## Call:
## lm(formula = e3_bw ~ h_pm10_ratio_preg_None + e3_asmokcigd_p_None +
##     as.factor(hs_cotinine_mcat_None), data = male.data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2066.82  -295.58    14.99   317.98  1334.33
##
## Coefficients:
##                                            Estimate Std. Error t value
## (Intercept)                                3704.145     69.717  53.131
## h_pm10_ratio_preg_None                      -11.493      2.971  -3.869
## e3_asmokcigd_p_None                         -33.854     12.243  -2.765
## as.factor(hs_cotinine_mcat_None)SHS smokers   65.385     69.692   0.938
## as.factor(hs_cotinine_mcat_None)Smokers       80.555     52.301   1.540
```

```
##                                             Pr(>|t|)
## (Intercept)                                  < 2e-16 ***
## h_pm10_ratio_preg_None                      0.000123 ***
## e3_asmokcigd_p_None                         0.005888 **
## as.factor(hs_cotinine_mcat_None)SHS smokers 0.348580
## as.factor(hs_cotinine_mcat_None)Smokers     0.124112
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 509.1 on 524 degrees of freedom
## Multiple R-squared:  0.04637,    Adjusted R-squared:  0.03909
## F-statistic:  6.37 on 4 and 524 DF,  p-value: 5.199e-05
```

```
# variance model based on child sex
variance.model <- aov(e3_bw ~ e3_sex_None, data = data)
summary(variance.model)
```

```
##              Df    Sum Sq Mean Sq F value  Pr(>F)
## e3_sex_None   1   5308973 5308973   20.88 5.5e-06 ***
## Residuals   998 253748566  254257
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

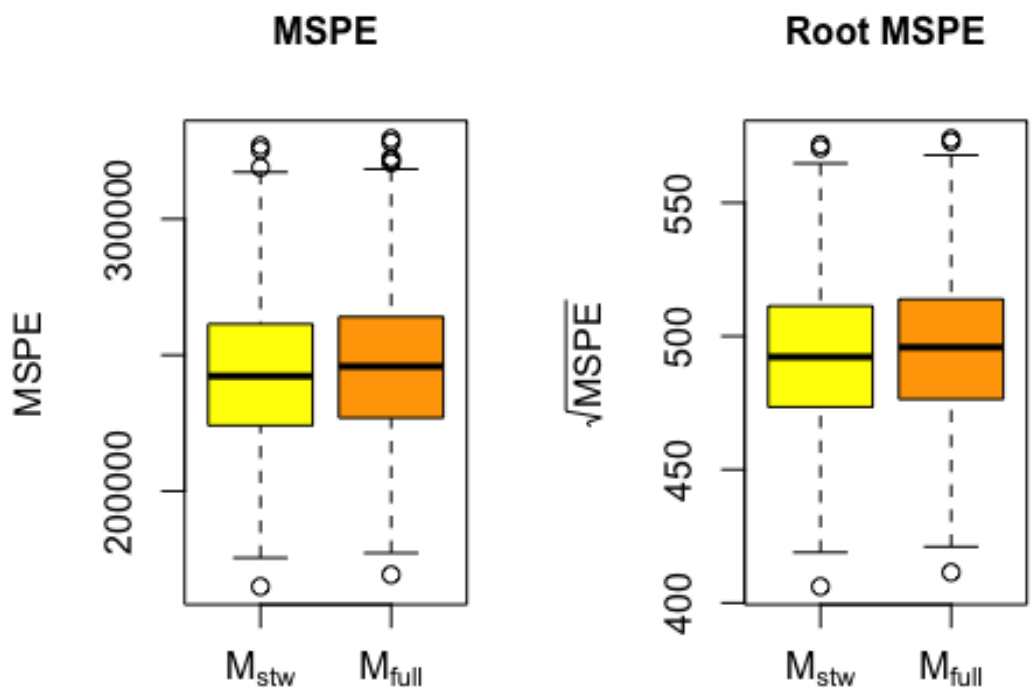
Appendix 12

```
Mstep <- lm(e3_bw ~ as.factor(e3_sex_None) + h_pm10_ratio_preg_None +
                    e3_asmokcigd_p_None + as.factor(hs_cotinine_mcat_None),
data = data)

testdata <- dataset

M1 <- Mstep
M2 <- Mfull
Mnames <- expression(M[stw], M[full])

nreps <- 1e3
ntot <- nrow(testdata)
ntrain <- 800
ntest <- ntot-ntrain

mspe1 <- rep(NA, nreps)
mspe2 <- rep(NA, nreps)

system.time({
  for(ii in 1:nreps) {
    if(ii%%100 == 0) message("ii = ", ii)

    train.ind <- sample(ntot, ntrain)
    M1.cv <- update(M1, subset = train.ind)
```

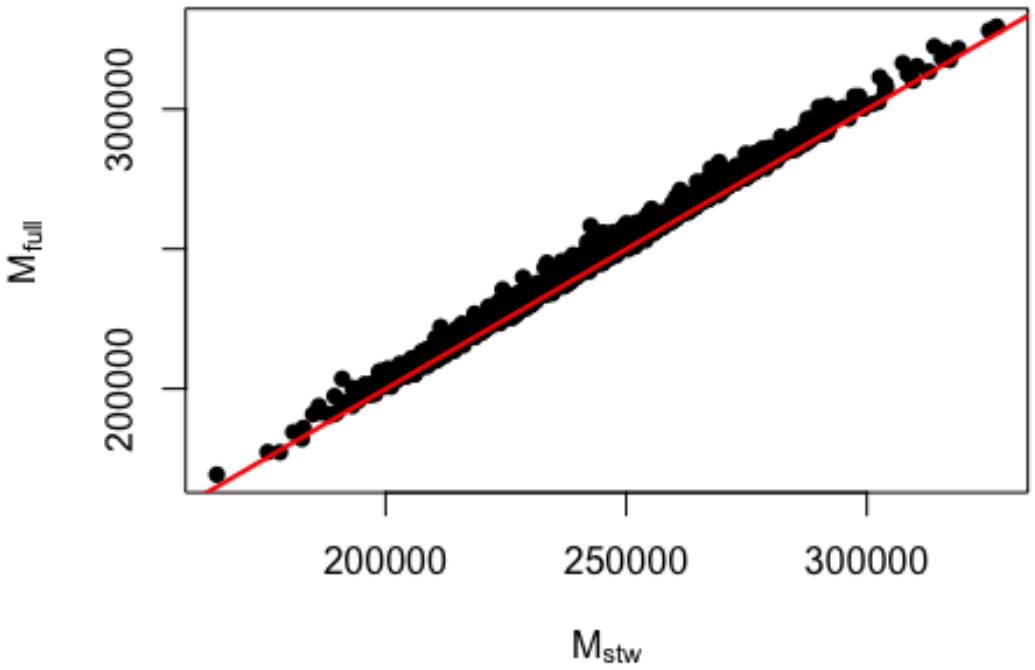
```
    M2.cv <- update(M2, subset = train.ind)

    M1.res <- testdata$e3_bw[-train.ind] -
      predict(M1.cv, newdata = testdata[-train.ind,])
    M2.res <- testdata$e3_bw[-train.ind] -predict(M2.cv, newdata =
testdata[-train.ind,])

    mspe1[ii] <- mean(M1.res^2)
    mspe2[ii] <- mean(M2.res^2)

  }
})
```

```
## ii = 100

## ii = 200

## ii = 300

## ii = 400

## ii = 500

## ii = 600

## ii = 700

## ii = 800

## ii = 900

## ii = 1000

##    user  system elapsed
##   6.044   0.060   6.109
```

```
par(mfrow = c(1,2))
cex <- 1
boxplot(x = list(mspe1, mspe2), names = Mnames,
        main = "MSPE",
        ylab = expression(MSPE),
        col = c("yellow", "orange"),
        cex = cex, cex.lab = cex, cex.axis = cex, cex.main = cex)
boxplot(x = list(sqrt(mspe1), sqrt(mspe2)), names = Mnames,
        main = "Root MSPE",
        ylab = expression(sqrt(MSPE)),
        col = c("yellow", "orange"),
        cex = cex, cex.lab = cex, cex.axis = cex, cex.main = cex)
```




```
par(mfrow=c(1,1))
plot(mspe1, mspe2, pch = 16,
     xlab = Mnames[1], ylab = Mnames[2],
     main = "")
abline(a = 0, b = 1, col= "red", lwd = 2)
```




```
PRESS1 <- resid(M1)/(1-hatvalues(M1))
PRESS2 <- resid(M2)/(1-hatvalues(M2))

#mean square prediction error
mean(PRESS1^2)

## [1] 243003.8

mean(PRESS2^2)

## [1] 245799.3
```