r-aq-analysis - Uppsala AQ

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This document explains the application of regression to aq data. The aq-data was collected over couple of months, and a part of it was used to study the applicatibility of linear regression. Earlier attempt was to use the calibration curve provided by the manufacturer, and then applying temperature compensation, that method had shortcomings, hence explorations into other methods is being used.

AQ

Summary first:

```
summary(aq.filtered)
```

```
##        X            Series        Time        Value
##  Min.   :  2.0000   O3:562   Min.   :NA   Min.   :128.7200
##  1st Qu.:144.2500            1st Qu.:NA   1st Qu.:209.6775
##  Median :288.5000            Median :NA   Median :225.4250
##  Mean   :288.2954            Mean   :NA   Mean   :220.5665
##  3rd Qu.:432.7500            3rd Qu.:NA   3rd Qu.:235.6050
##  Max.   :576.0000            Max.   :NA   Max.   :253.6100
##       temp            humidity        aq_resistance
##  Min.   :10.55000   Min.   :17.26000   Min.   :3.410000
##  1st Qu.:11.48250   1st Qu.:51.66125   1st Qu.:3.590000
##  Median :12.70500   Median :62.61500   Median :3.630000
##  Mean   :14.46835   Mean   :58.01204   Mean   :3.618944
##  3rd Qu.:15.57500   3rd Qu.:66.83375   3rd Qu.:3.650000
##  Max.   :41.07000   Max.   :69.58000   Max.   :3.690000
##       pred
##  Min.   :138.2715
##  1st Qu.:212.6520
##  Median :224.7650
##  Mean   :220.5665
##  3rd Qu.:234.2539
##  Max.   :243.7077
```

Regression with Value and aq resistance

```
##
## Call:
## lm(formula = Value ~ aq_resistance, data = aq.filtered)
##
## Coefficients:
##   (Intercept)  aq_resistance
##    -1165.6800       383.0527
```

Regression with Value and aq resistance, adding temperature, slightly better r^2:

```
##
```

```
## Call:
## lm(formula = Value ~ aq_resistance + temp, data = aq.filtered)
##
## Coefficients:
##   (Intercept)  aq_resistance           temp
##    -804.00231      287.27646       -1.04149
```

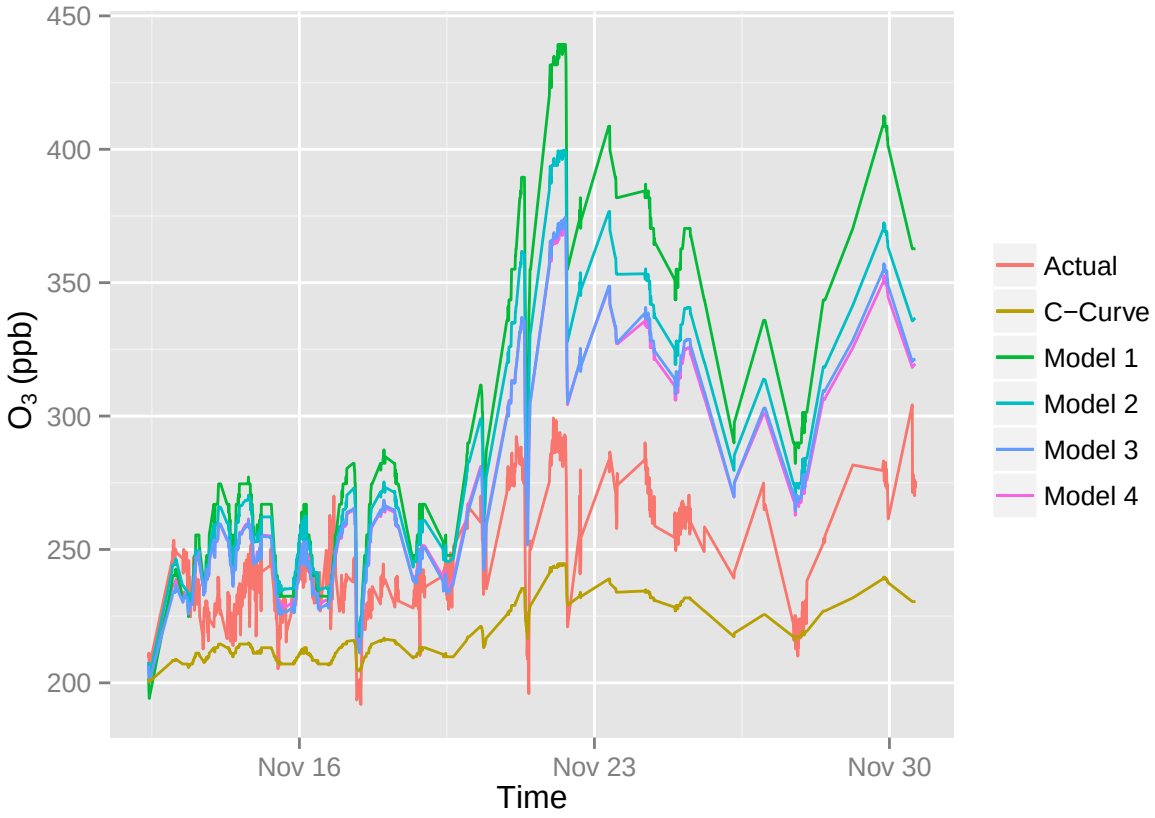
Multivariate with 3 , adding humidity and temperature increases the r^2:

```
##
## Call:
## lm(formula = Value ~ aq_resistance + humidity + temp, data = aq.filtered)
##
## Coefficients:
##   (Intercept)  aq_resistance       humidity           temp
##  -739.8246423    259.8208715      0.4408594     -0.3774600
```

Statistical test using ANOVA

```
## Analysis of Variance Table
##
## Model 1: Value ~ aq_resistance
## Model 2: Value ~ aq_resistance + temp
## Model 3: Value ~ aq_resistance + humidity
## Model 4: Value ~ aq_resistance + humidity + temp
##   Res.Df       RSS Df Sum of Sq        F           Pr(>F)
## 1    560 58083.635
## 2    559 53507.281  1 4576.3538 50.48002 0.00000000000369 ***
## 3    559 50953.682  0 2553.5986
## 4    558 50586.463  1  367.2196  4.05066         0.044634 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Regression analysis on test data (rest of the month)



As you can see the calibrated curve method has poor response, but the regression models 3 and 4 show almost intandem pattern wrt to aq egg.

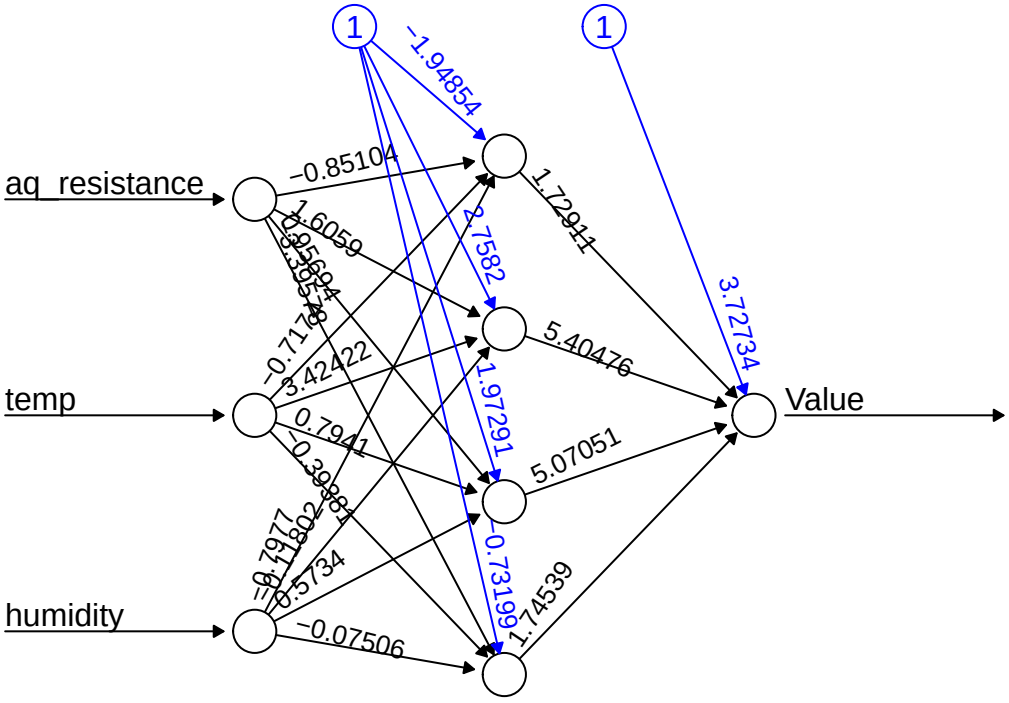
ANN analysis

```
## build the neural network (NN)
aqnet <- neuralnet(Value ~ aq_resistance + temp+ humidity, aq.filtered, hidden = 4,
          lifesign = "minimal", linear.output = FALSE, threshold = 0.1)
```

```
## hidden: 4    thresh: 0.1    rep: 1/1    steps:      40    error: 13667701.72  time: 0.01 secs
```

Question here is that, what does the above mean , Steps ~25 and Error in milions

```
## plot the NN
plot(aqnet, rep = "best")
```



Error: 13667701.724526 Steps: 40