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ཚལ་ལྷན་ཁག། ནགས་ཚལ་དང་གླིང་ཀ་ཞབས་
ཏོག་ལས་ཁུངས།

Royal Government of Bhutan
Ministry of Agriculture and Forests
Department of Forests and Park Services

SPECIES SPECIFIC VOLUME EQUATION TO ESTIMATE MERCHANTABLE VOLUME

Conifers

Forest Resources Management Division
Department of Forest and Park Services
Ministry of Agriculture and Forests

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General volume equation to estimate merchantable volume

Conifers

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1. Summary

The volume equation developed in this study will predict the merchantable volume of *Conifer*. The merchantability standard for volume calculation adopted for this study is 10 cm and above diameter at breast height (dbh) and top diameter measured up to 10 cm over bark.

A total of 16 models were fitted. First 4 models were fitted with volume as a function of diameter at breast height (DBH), while models 5 – 8 were fitted with basal area (BA) as the predictor variable. With product of squared diameter at breast height and height (DBH2H) as predictor variable, 4 models, namely the models 9 – 12 were fitted. The last four models, 13 -16 were fitted with product of basal area and height (BAH) as the predictor.

The initial plots of response (volume) variables and predictor (DBH, BA, DBH2H and BAH) variables clearly indicated presence of heteroscedasticity, which has been modeled using variance functions (varFixed, varPower and varConstPower) in gls ( ) function of nlme package.

Of the sixteen, two models viz model 7 and model 16 have been selected as the best fit models for the models fitted with and without height as predictors respectively. The model 7 had AIC and BIC values of 546 and 568 respectively, whereas the model 16 had AIC and BIC values of -333 and -306 respectively. Lower the AIC and BIC values, better the fit of the model.

The performance of the selected models was assessed by comparing the actual volume with the volumes predicted by two selected models for each tree. From the assessment, the model 16 which uses height performs much better than the model 7. Besides the AIC and BIC values for model 16 are lower vis-à-vis model 7, thus, the model 16 is considered the best fit model for *Conifer* out of the 16 models fitted. And the model 7 is best fit model without height.

2. Introduction

The volume equations, developed during pre-investment survey (PIS) carried out between 1974-81 predict total tree volume, and not the merchantable volume of trees. The recent change of policy of the Department of Forests and Park Services to allot timber for rural house construction in the form of log volume instead of allotting by number of trees as was once practiced, has necessitated development of merchantable log volume equation.

Therefore, standards of merchantability adopted for this study to develop merchantable log volume equation are trees of 10 cm and above diameter at breast height (dbh) and the sections up to 10 cm top diameter over the bark.

As was done for PIS exercise to develop volume equation, this study ignores/does not consider the volume of foliage and branches for the purpose of calculating the merchantable volume. This decision stems from the objective, which is to estimate merchantable log volume. Moreover, branches are rarely used as timber (at least in Bhutan) and are mostly used for firewood.

The sample trees for this study have been felled as part of biomass equation development field work. The data protocol for biomass equation development required collecting a minimum of 8 trees each from four regions of Bhutan namely, eastern, eastern central, western and western central. Besides, biomass field work, field work to collect additional data was conducted in the month of November, 2018 – January, 2019 involving staff from Paro Division and FRMD Inventory Team. Therefore, a total of 583 trees have been felled and used for modeling *Conifer* in this study.

The trees were felled at 0.3 m height from the ground at which the diameter was measured and recorded. Then diameter at zero height (ground level) were also measured and recorded. After felling, the diameter was measured at 0.7 m from 0.3 m height (essentially making 1 m height, i.e 0.3 m + 0.7 m =1 m). Thereafter, at every meter length, the diameter was measured and recorded, thus making many 1 m length sections of log. As mentioned above the smallest top diameter considered for merchantable log volume calculation was up to 10 cm diameter over bark. Top sections below 10 cm diameter have been discarded.

3. Volume Calculation

Trees after felling are converted into different sizes of sections depending on the requirement and demand. Sections with length of 8 or more feet long are called logs and shorter ones are called sticks or bolts (Avery and Burkhart, 1994). The scaling or measuring the volume of the section is done by multiplying the length with the cross-sectional area of the section. Although they rarely form true circles, they are assumed so for the purpose of calculating cross sectional area in meter square, which is

$$\text{Cross sectional area (A)} = A = \pi r^2 = \frac{\pi D^2}{4 * 10000} \qquad (1)$$

Where **r** is radius in meters and **D** is diameter at breast height in centimeters.

From the ground level to 0.3 m height (height at which sample tree has been cut) is section I, while 0.3 m to 0.7 m is section II. The subsequent sections of 1 m length each are numbered III, IV and so on. The last section is the terminal section, whose length is equal to or less than 1 m.

The most commonly used formulae for calculating volume are the Huber, Newton and Smalian's formulae (Sadiq, 2006, and Goulding, 1979). Of the three commonly used volume calculation approaches or formulae, the Smalian's formula has been used to calculate volume (in m^3) for this study, which is;

$$\text{Section volume } (V_s) = \frac{A+a}{2} * L \qquad (2)$$

Where A = Cross sectional area in m^2 at large end of the section
a = Cross sectional area in m^2 at small end of the section
L = Length of the section in meter

Smalian's formula is the easiest and least expensive to apply and therefore applied to get volume for each section of the sample trees. However, for the terminal section, the following formula was used to calculate the volume;

$$\text{Terminal section volume } (V_t) = \frac{A}{3} * L \qquad (3)$$

The volume for sections and terminal section for individual trees were then summed to obtain the total volume for each individual sample tree, which is;

$$\text{Volume of tree (V)} = \sum_{s=1}^{n} V_s + V_t \qquad (4)$$

After obtaining individual tree volume (Volume.m3), it was then tabulated against the variables - height in meter (Height.m) and the diameter at breast height in centimeter (DBH.cm). The branch and foliage volumes have been ignored for calculating the merchantable volume.

4. The Dataset used for modeling volume of Conifer

A total of 583 trees have been felled and collected data for developing general merchantable volume equation for conifers in this study. Besides, data collected by biomass team, the field work to collect additional data was conducted in the month of November, 2018 – January, 2019 involving staff from Paro Division and Inventory Team of FRMD. Summary of the dataset is presented below, while the detailed dataset is provided as annexure.

4.1 Summary descriptive statistics of *Conifer* dataset

```
> summary(allC)
      Tree_ID         Height.m          DBH.cm           Volume.m3
 ade01   :  1    Min.   : 4.60    Min.   : 10.00    Min.   : 0.01813
 ade02   :  1    1st Qu.:14.35    1st Qu.: 23.00    1st Qu.: 0.26590
 ade03   :  1    Median :22.10    Median : 38.00    Median : 1.29480
 ade04   :  1    Mean   :23.80    Mean   : 41.85    Mean   : 2.36323
 ade05   :  1    3rd Qu.:31.00    3rd Qu.: 57.30    3rd Qu.: 3.40635
 ade06   :  1    Max.   :66.80    Max.   : 136.00   Max.   : 16.71401

     BA.m2               BAH.m3            DBH2H.m3
 Min.   :0.007854   Min.   : 0.05716   Min.   : 0.07278
 1st Qu.:0.041548   1st Qu.: 0.58536   1st Qu.: 0.74530
 Median :0.113411   Median : 2.74889   Median : 3.50000
 Mean   :0.175336   Mean   : 5.40885   Mean   : 6.88677
 3rd Qu.:0.257870   3rd Qu.: 7.93240   3rd Qu.: 10.09985
 Max.   :1.452672   Max.   : 43.75108  Max.   : 55.70560
```

5. Fitting the models

The models have been fitted in R, which is a robust statistical computing environment. It is a powerful tool which provides wide range of statistical and graphical options to explore, calculate and manage data besides modelling. It is very powerful and widely used statistical tool which is free and allows user to customize the scripts depending on desired output, which is not possible in many of the statistical softwares.

After reading in the excel files into R, we created other variables namely; basal area in square meter (BA.m2), basal area in meter times height in meter (BAH.m3) and square of the diameter in meter times height in meter (DBH2H.m3). The height in meter (Height.m) and diameter in centimeter (DBH.cm) were measured and recorded in the field.

Prior to fitting models, we explored and examined each set of data by preparing descriptive summaries that provided mean, median and range of dependent/response and independent/predictor variables. Then we plotted scatter graphs which provided sense of relationship between the dependent/response (volume) and independent/predictor variables (namely DBH.cm, BA.m2, DBH2H.m3 and BAH.m3). These graphs showed curvilinear relationship between response and predictor variables. The scatter plots also clearly revealed the presence of phenomenon, referred in statistical parlance, as heteroscedasticity, which is the increase in variation in response (volume) variable with increase in value of the predictor variables.

Therefore, we fitted the models using the gls ( ) function of the nlme package of R, because the gls ( ) function has the capability to model heteroscedasticity. We didn't transform the variables, mainly response variable, because transformation makes it difficult to directly interpret the relationship between response and predictor variables; and secondly to compare the AIC and BIC values among the different models, the response variables need to be identical.

The models were fitted with volume as a function of four variables;

1) DBH.cm,
2) BA.m2,
3) DBH2H.m3 and
4) BAH.m3.

For each of the variable, we fitted one simple gls ( ) function, which can be written in the following form;

$$Y = \beta_0 + \beta_1 X + \varepsilon, \qquad (5)$$

Where Y = Volume (V) and X = predictor variable

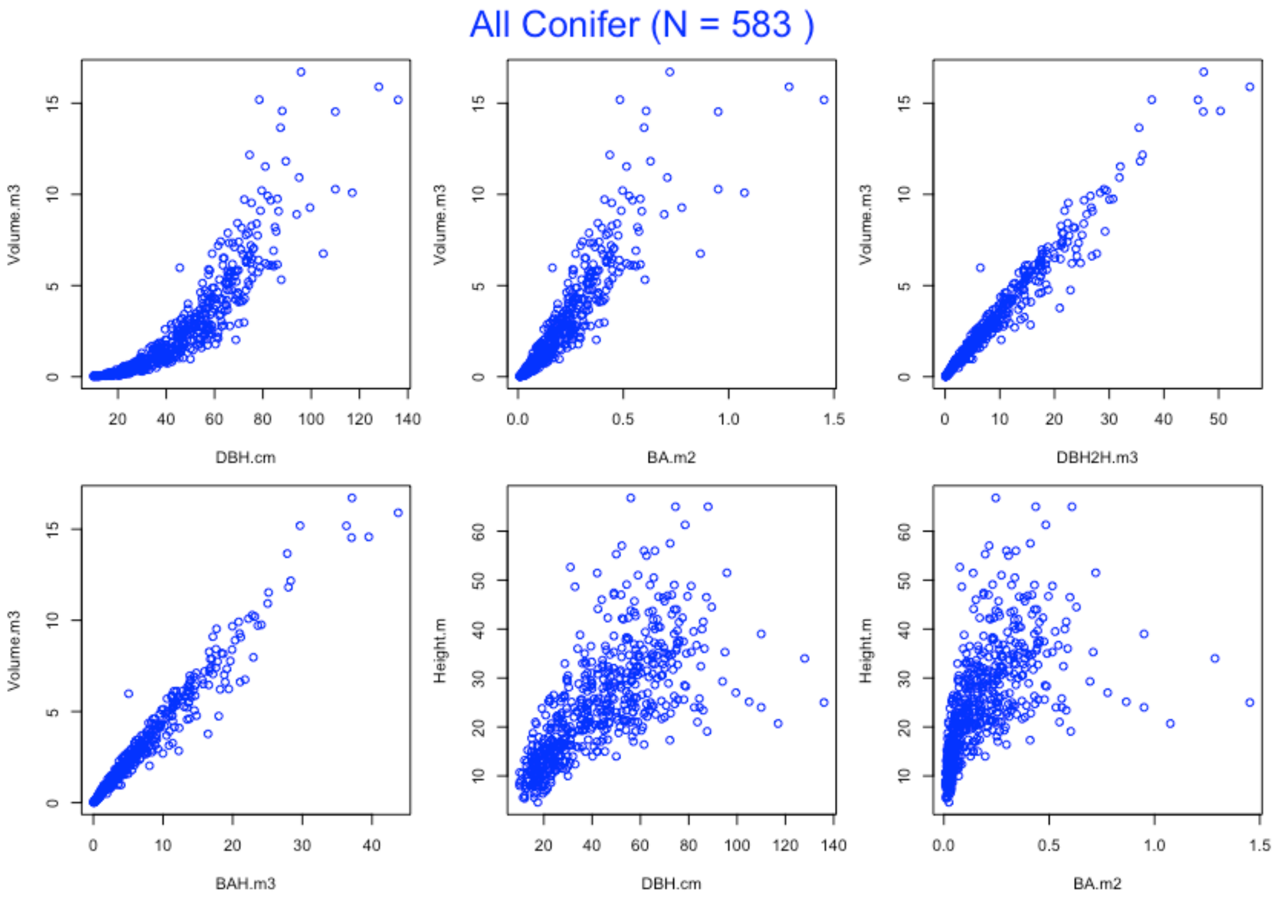
And then fitted 3 models with restricted natural cubic spline functions. The restricted natural cubic spline function enables better tracking of curvilinear relationship between response and predictor variables. These models introduce an additional predictor variable as part of a 3 knot-cubic spline. They take the following forms;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon, \qquad (6)$$

Where Y = Response variable, volume (V)
X_1 = Predictor variable
$X_2 = g(X_1)$

And $g(X_1)$ is the spline transformation of X_1 predictor variable

6. Summary Plots



7. Models and results

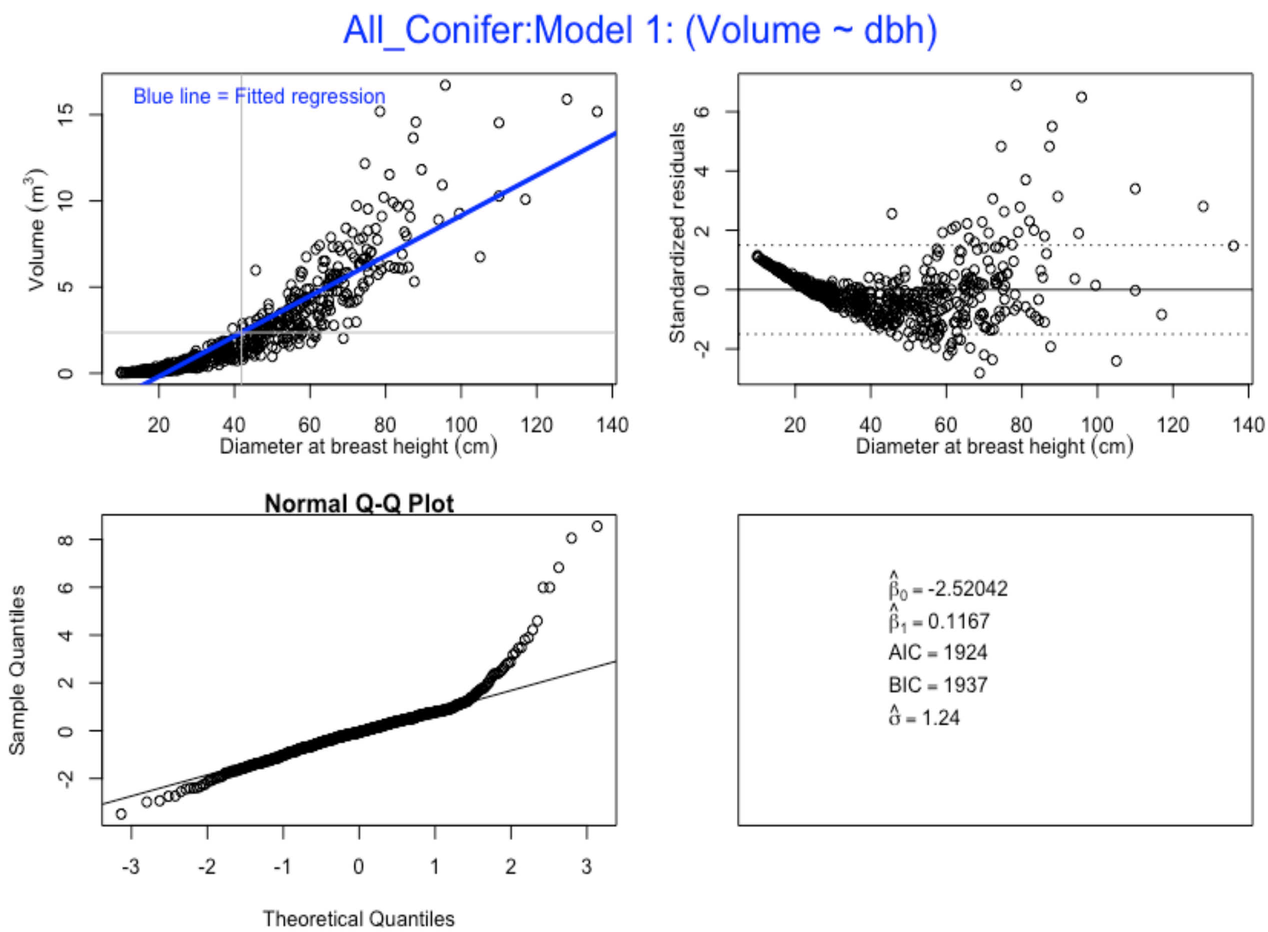
7.1 Model 1 - Volume with diameter at breast height (DBH) as predictor

```
> allC.m1 <- gls(Volume.m3 ~ DBH.cm)
> summary(allC.m1)

Generalized least squares fit by REML
  Model: Volume.m3 ~ DBH.cm
  Data: NULL
       AIC      BIC    logLik
  1924.128 1937.222 -959.0641

Coefficients:
                 Value  Std.Error   t-value p-value
(Intercept) -2.5204237 0.11065323 -22.77768       0
DBH.cm       0.1167016 0.00234193  49.83136       0
```

Plot of model 1



7.2 Model 2 - Volume with diameter at breast height (DBH) as predictor, with varFixed

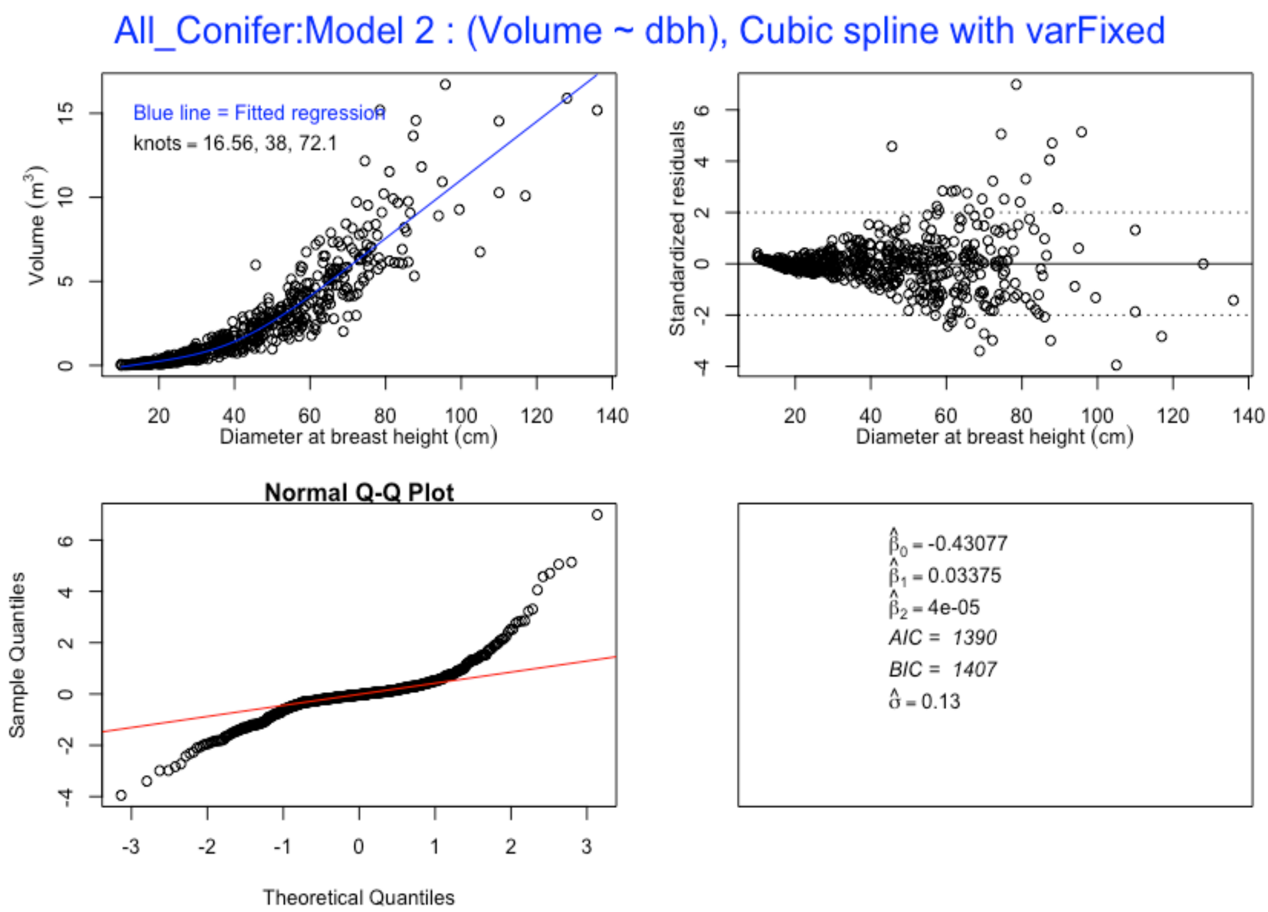
```
> allC.m2 <- gls(Volume.m3 ~ DBH.cm + DBH.cm.splinepoints,
               na.action=na.omit, weights = varFixed(~DBH.cm))
> summary(allC.m2)

Generalized least squares fit by REML
  Model: Volume.m3 ~ DBH.cm + DBH.cm.splinepoints
  Data: NULL
       AIC      BIC    logLik
  1389.976 1407.428 -690.9878

Variance function:
 Structure: fixed weights
 Formula: ~DBH.cm

Coefficients:
                         Value  Std.Error   t-value p-value
(Intercept)         -0.4307664 0.09565314 -4.503421       0
DBH.cm               0.0337528 0.00391678  8.617503       0
DBH.cm.splinepoints  0.0000392 0.00000208 18.849435       0
```

Plot of Model 2



7.3 Model 3- Volume with diameter at breast height (DBH) as predictor, with varPower

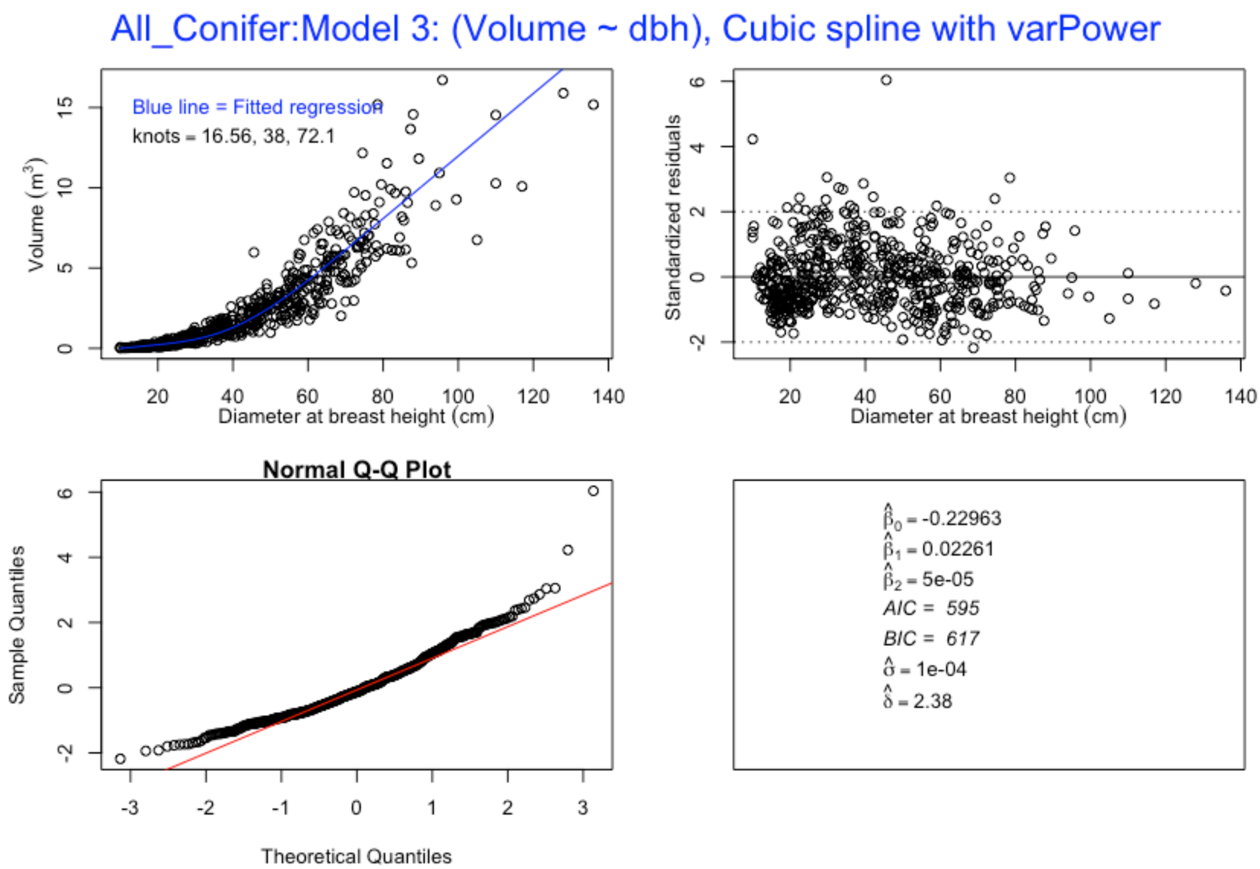
```
> allC.m3 <- gls(Volume.m3 ~ DBH.cm + DBH.cm.splinepoints,
              na.action=na.omit, weights = varPower(form =
              ~DBH.cm))
> summary(allC.m3)

Generalized least squares fit by REML
  Model: Volume.m3 ~ DBH.cm + DBH.cm.splinepoints
  Data: NULL
       AIC      BIC    logLik
  595.3129 617.128 -292.6564

Variance function:
 Structure: Power of variance covariate
 Formula: ~DBH.cm
 Parameter estimates:
  power
2.38213

Coefficients:
                          Value   Std.Error   t-value p-value
(Intercept)         -0.22963335 0.014593016 -15.73584       0
DBH.cm               0.02261212 0.000951631  23.76144       0
DBH.cm.splinepoints  0.00004820 0.000001517  31.77941       0
```

Plot of Model 3



7.4 Model 4 - Volume with diameter at breast height (DBH) as predictor, with varConstPower

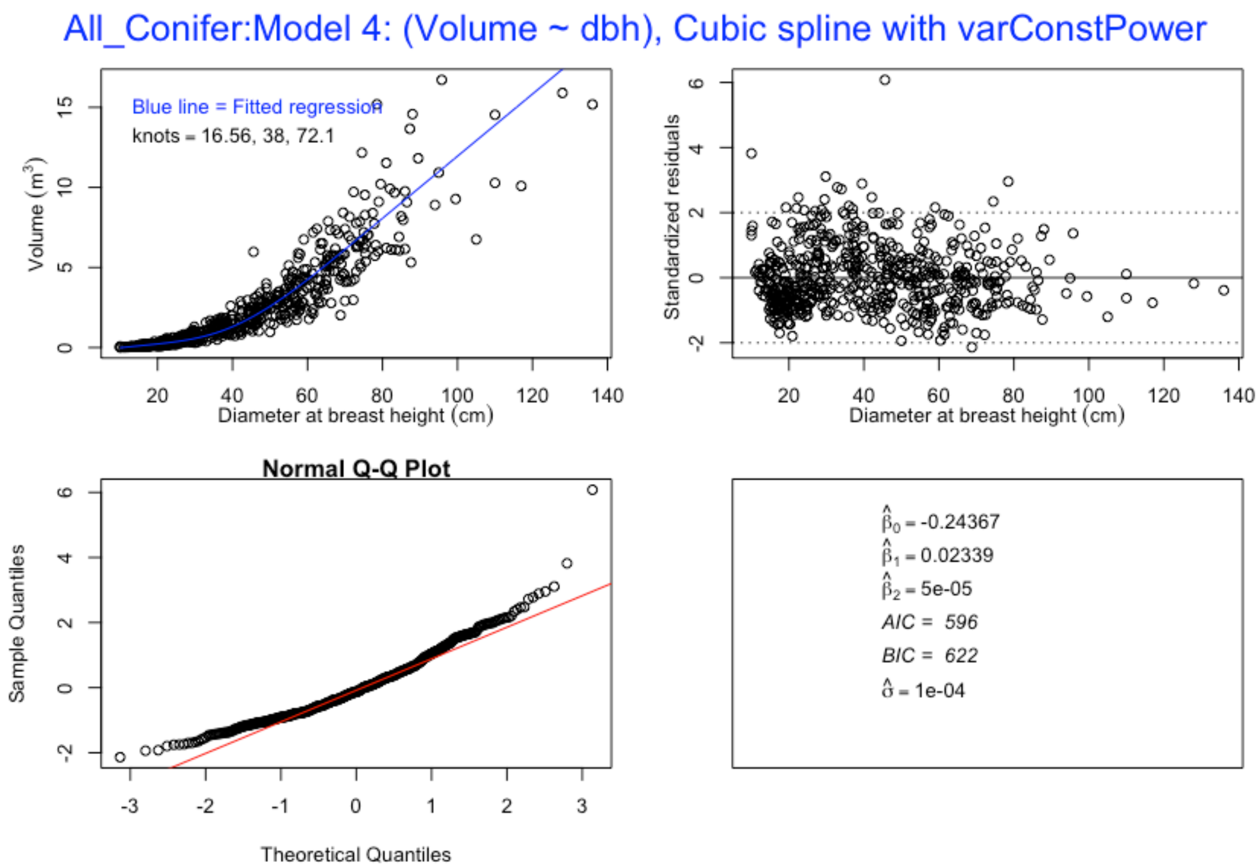
```
> allC.m4 <- gls(Volume.m3 ~ DBH.cm + DBH.cm.splinepoints,
             na.action=na.omit, weights = varConstPower(form =
             ~DBH.cm))
> summary(allC.m4)

Generalized least squares fit by REML
  Model: Volume.m3 ~ DBH.cm + DBH.cm.splinepoints
  Data: NULL
       AIC      BIC    logLik
  595.8322 622.0104 -291.9161

Variance function:
 Structure: Constant plus power of variance covariate
 Formula: ~DBH.cm
 Parameter estimates:
     const      power
112.614346   2.465931

Coefficients:
                          Value   Std.Error   t-value p-value
(Intercept)         -0.24367106 0.015636894 -15.58309       0
DBH.cm               0.02338672 0.000987618  23.67994       0
DBH.cm.splinepoints  0.00004775 0.000001549  30.83333       0
```

Plot of Model 4



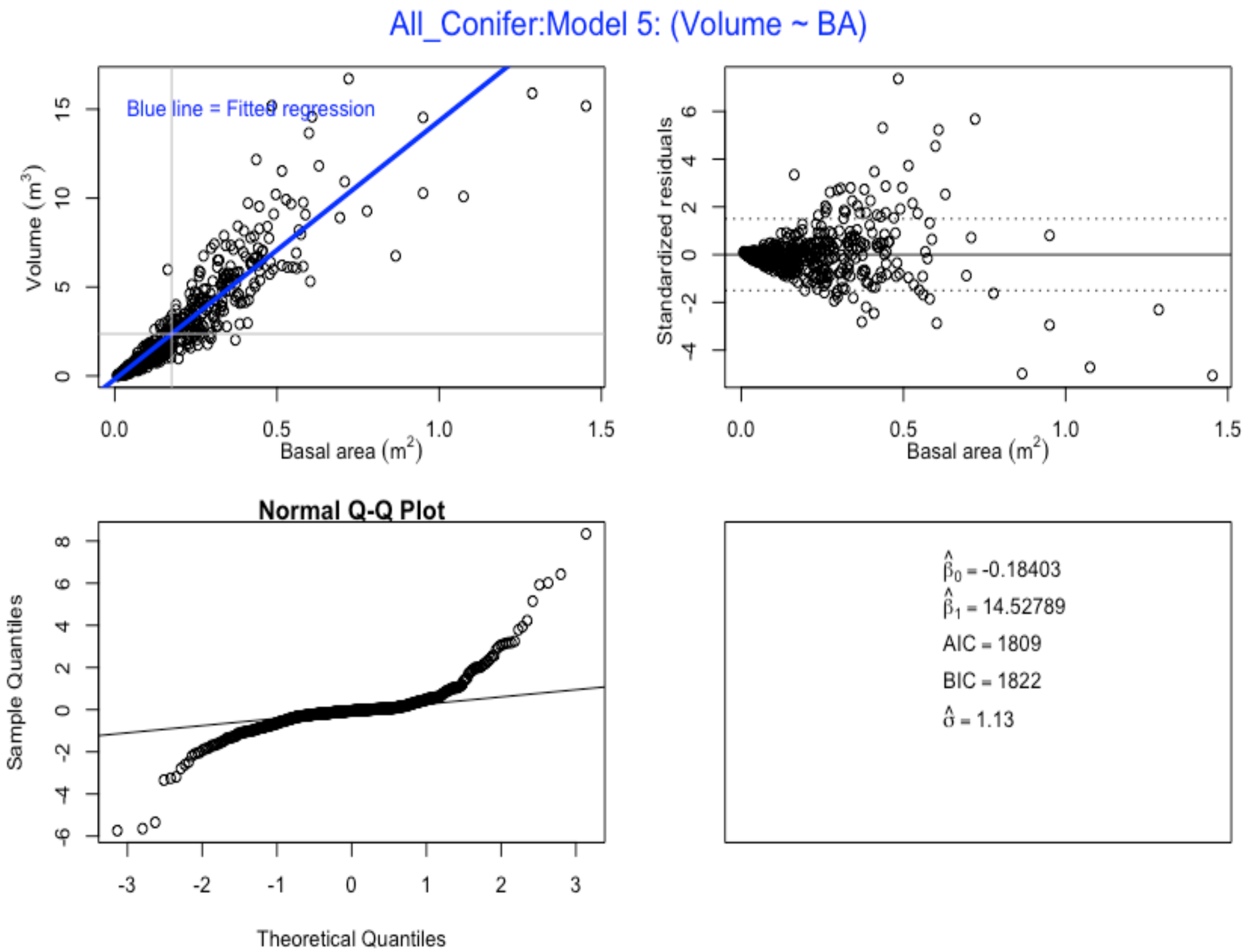
7.5 Model 5 - Volume with basal area (BA) as predictor

```
> allC.m5 <- gls(Volume.m3 ~ BA.m2)
> summary(allC.m5)

Generalized least squares fit by REML
  Model: Volume.m3 ~ BA.m2
  Data: NULL
       AIC      BIC    logLik
  1809.224 1822.319 -901.6122

Coefficients:
                Value  Std.Error  t-value p-value
(Intercept) -0.184027 0.06557769 -2.80624  0.0052
BA.m2       14.527894 0.26126693 55.60556  0.0000
```

Plot of Model 5



7.6 Model 6 - Volume with basal area (BA) as predictor, with varFixed

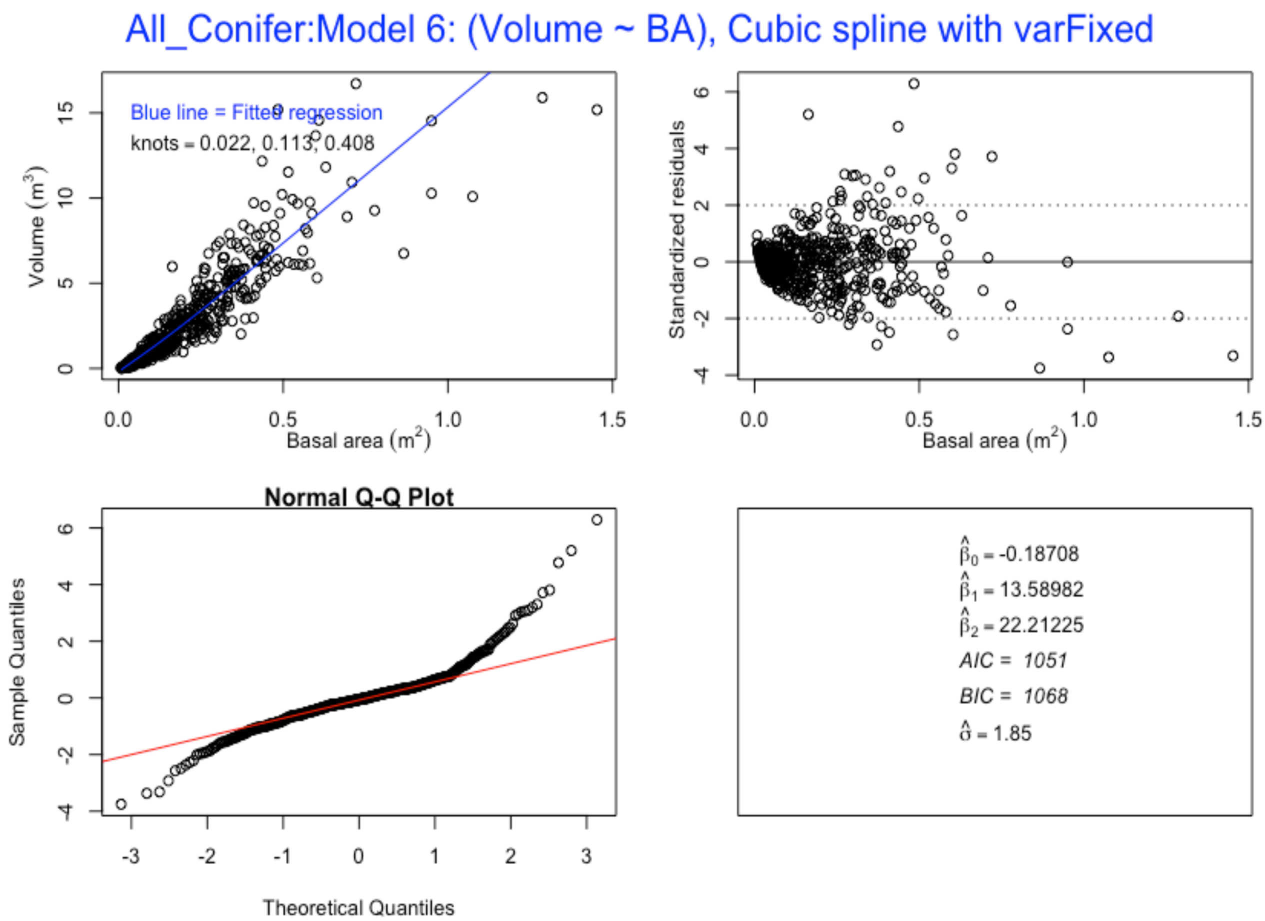
```
> allC.m6<- gls(Volume.m3 ~ BA.m2 + BA.m2.splinepoints,
             na.action=na.omit, weights = varFixed(~BA.m2))
> summary(allC.m6)

Generalized least squares fit by REML
  Model: Volume.m3 ~ BA.m2 + BA.m2.splinepoints
  Data: NULL
       AIC      BIC    logLik
  1050.819 1068.271 -521.4097

Variance function:
 Structure: fixed weights
 Formula: ~BA.m2

Coefficients:
                      Value Std.Error   t-value p-value
(Intercept)        -0.18708  0.027996 -6.682337  0.0000
BA.m2              13.58982  0.524137 25.927976  0.0000
BA.m2.splinepoints 22.21225  8.768148  2.533288  0.0116
```

Plot of Model 6



7.7 Model 7 Volume with basal area (BA) as predictor, with varPower

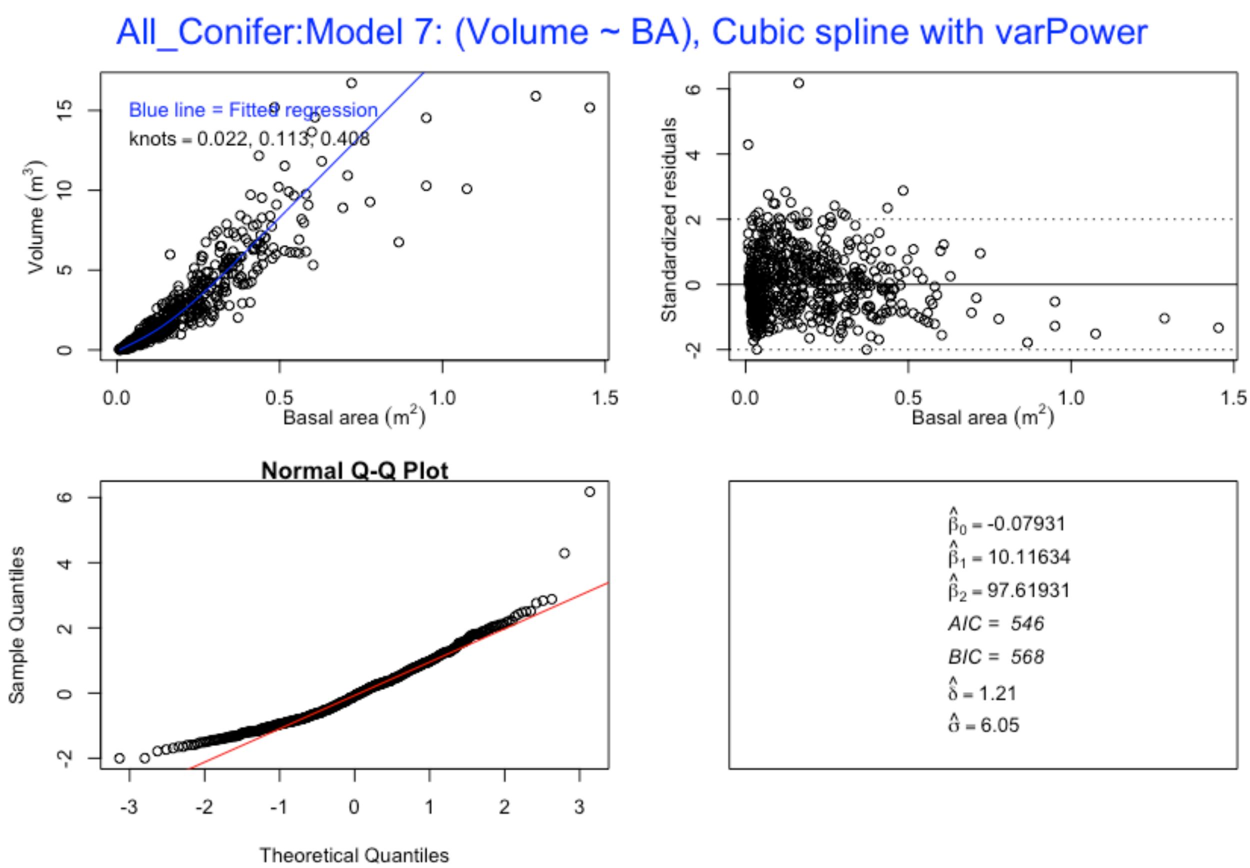
```
> allC.m7 <- gls(Volume.m3 ~ BA.m2 + BA.m2.splinepoints,
na.action=na.omit, weights = varPower(form = ~BA.m2))
> summary(allC.m7)
```

```
Generalized least squares fit by REML
  Model: Volume.m3 ~ BA.m2 + BA.m2.splinepoints
  Data: NULL
       AIC      BIC    logLik
  546.4185 568.2337 -268.2093

Variance function:
 Structure: Power of variance covariate
 Formula: ~BA.m2
 Parameter estimates:
   power
1.214038

Coefficients:
                       Value Std.Error   t-value p-value
(Intercept)         -0.07931  0.006582 -12.04937       0
BA.m2               10.11634  0.285398  35.44641       0
BA.m2.splinepoints  97.61931  8.982205  10.86808       0
```

Plot of Model 7



7.8 Model 8 – Volume with basal area (BA) as predictor, with varConstPower

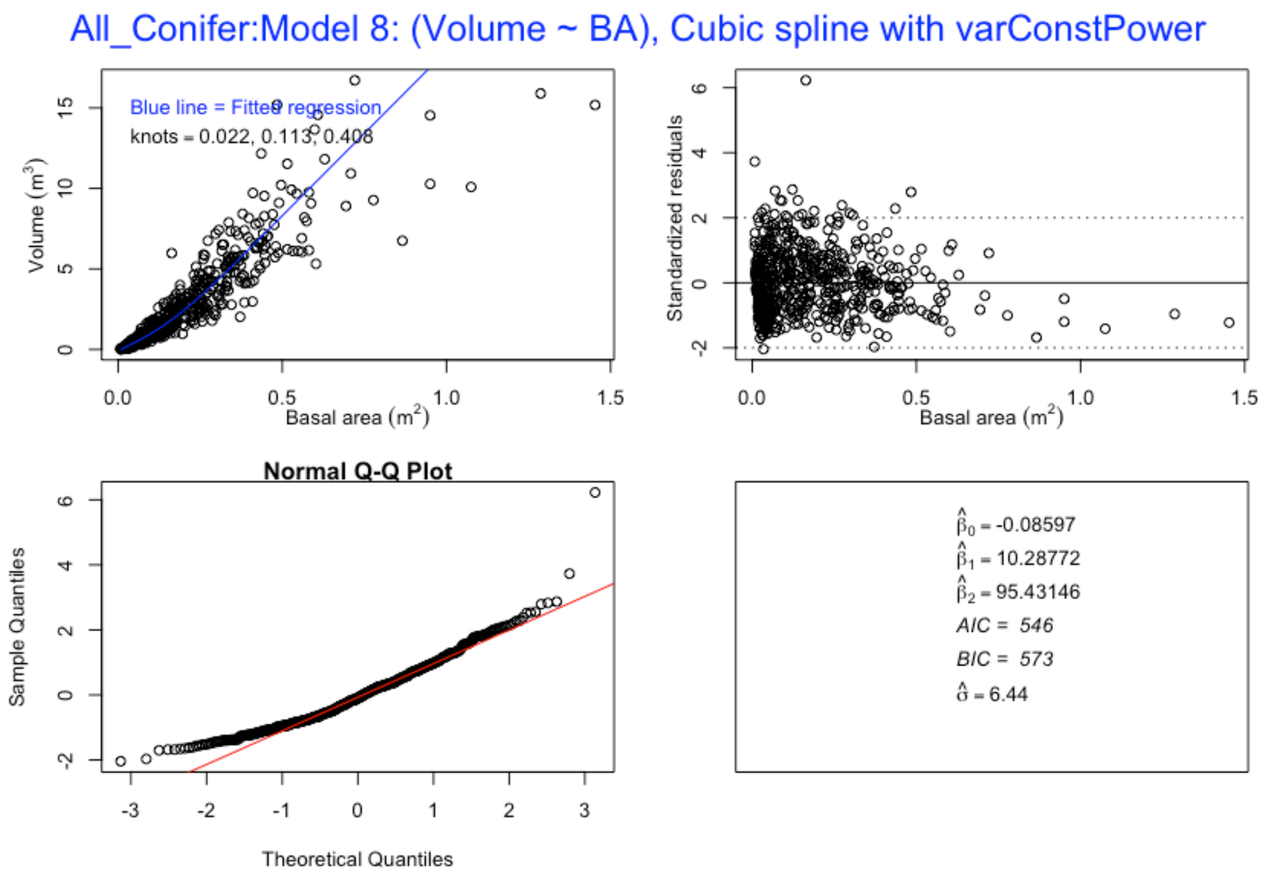
```
> allC.m8 <- gls(Volume.m3 ~ BA.m2 + BA.m2.splinepoints,
              na.action=na.omit, weights = varConstPower(form =
              ~BA.m2))
> summary(allC.m8)

Generalized least squares fit by REML
  Model: Volume.m3 ~ BA.m2 + BA.m2.splinepoints
  Data: NULL
      AIC      BIC    logLik
  546.323 572.5012 -267.1615

Variance function:
 Structure: Constant plus power of variance covariate
 Formula: ~BA.m2
 Parameter estimates:
      const       power
0.001006119 1.260064931

Coefficients:
                      Value Std.Error   t-value p-value
(Intercept)        -0.08597  0.007162 -12.00448       0
BA.m2              10.28772  0.290281  35.44062       0
BA.m2.splinepoints 95.43146  9.204884  10.36748       0
```

Plot of Model 8



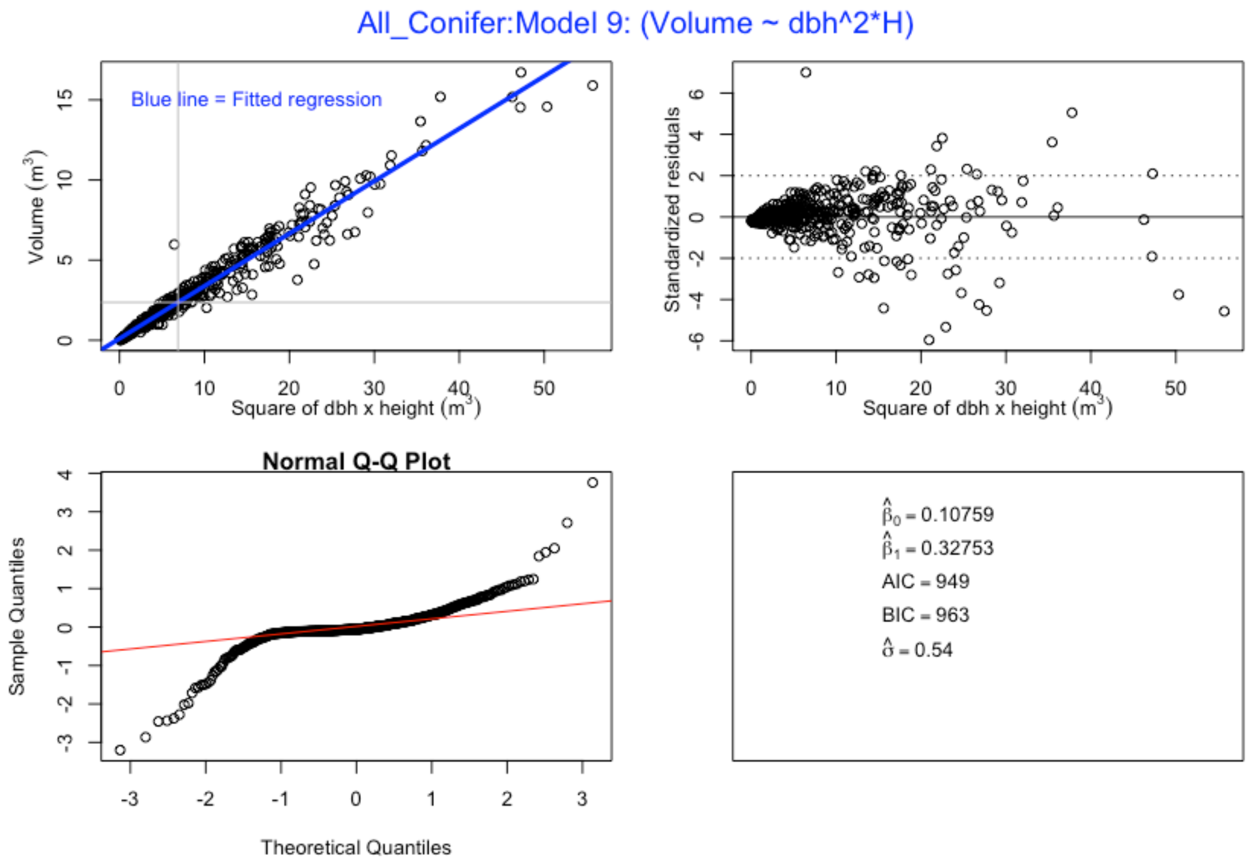
7.9 Model 9 – Volume with square of diameter at breast height * height (DBH2H) as predictor

```
> allC.m9 <- gls(Volume.m3 ~ DBH2H.m3)
> summary(allC.m9)

Generalized least squares fit by REML
  Model: Volume.m3 ~ DBH2H.m3
  Data: NULL
       AIC      BIC    logLik
  949.4367 962.531 -471.7184

Coefficients:
                Value   Std.Error   t-value p-value
(Intercept) 0.1075947 0.028590006   3.76337   2e-04
DBH2H.m3    0.3275317 0.002608392 125.56845   0e+00
```

Plot of Model 9



7.10 Model 10 – Volume with square of diameter at breast height * height (DBH2H) as predictor, with varFixed

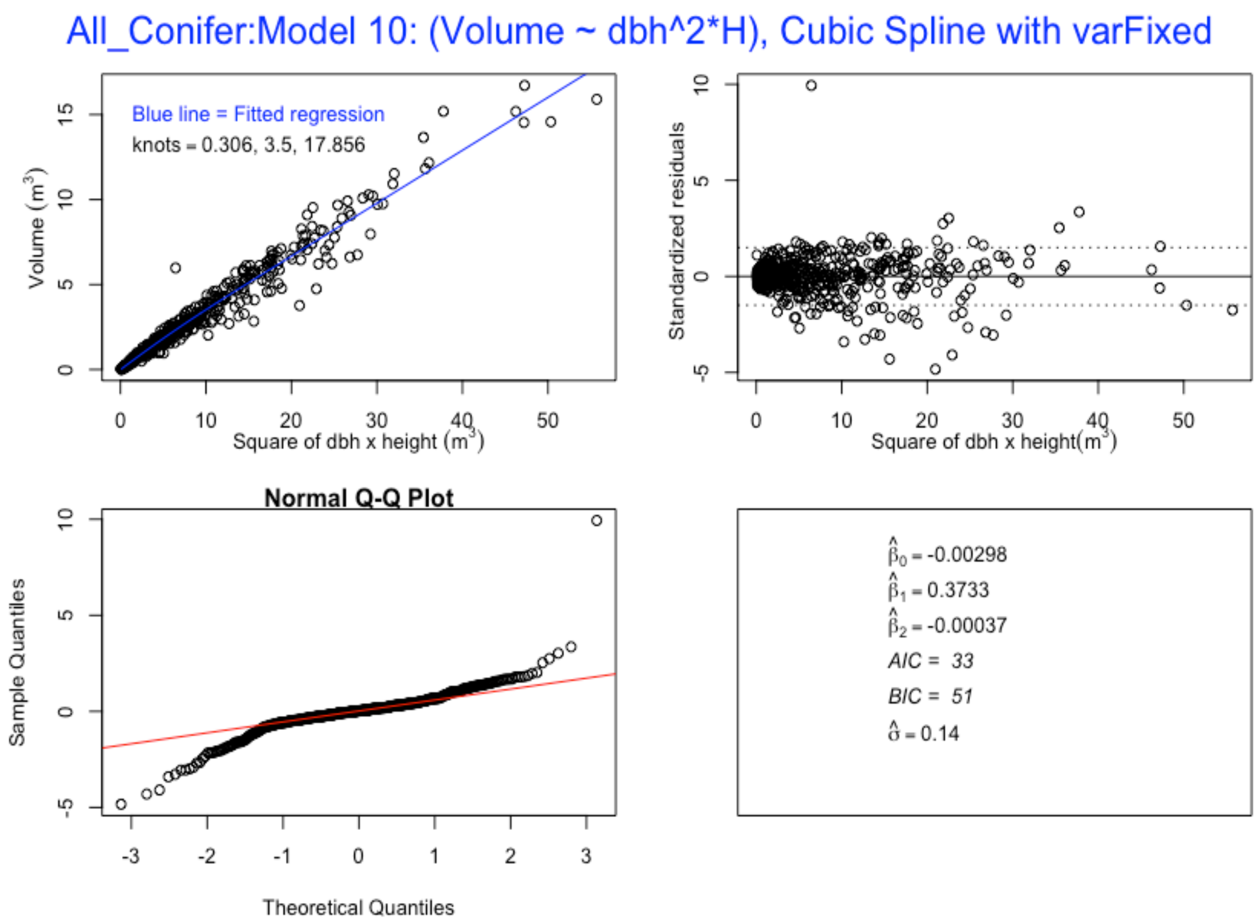
```
> allC.m10 <- gls(Volume.m3 ~ DBH2H.m3 + DBH2H.m3.splinepoints,
               na.action=na.omit, weights = varFixed(~DBH2H.m3))
> summary(allC.m10)

Generalized least squares fit by REML
  Model: Volume.m3 ~ DBH2H.m3 + DBH2H.m3.splinepoints
  Data: NULL
       AIC      BIC    logLik
  33.43845 50.89056 -12.71923

Variance function:
 Structure: fixed weights
 Formula: ~DBH2H.m3

Coefficients:
                           Value   Std.Error  t-value p-value
(Intercept)           -0.0029787 0.006757521 -0.44080  0.6595
DBH2H.m3               0.3732979 0.005779469 64.59034  0.0000
DBH2H.m3.splinepoints -0.0003682 0.000059550 -6.18287  0.0000
```

Plot of Model 10



7.11 Model 11– Volume with square of diameter at breast height * height (DBH2H) as predictor, with varPower

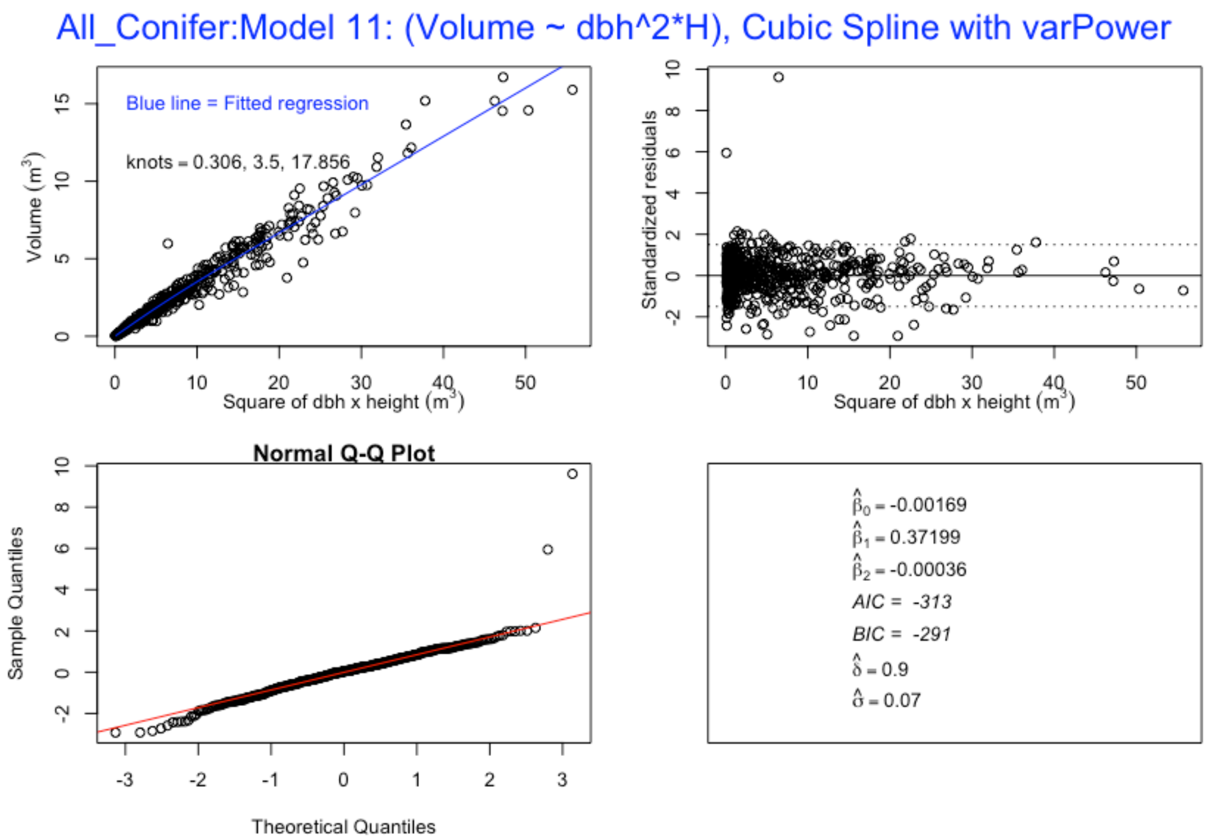
```
> allC.m11 <- gls(Volume.m3 ~ DBH2H.m3 + DBH2H.m3.splinepoints,
                 na.action=na.omit, weights = varPower(form =
                 ~DBH2H.m3))
> summary(allC.m11)
```

```
Generalized least squares fit by REML
  Model: Volume.m3 ~ DBH2H.m3 + DBH2H.m3.splinepoints
  Data: NULL
        AIC       BIC   logLik
  -313.1688 -291.3536 161.5844

Variance function:
 Structure: Power of variance covariate
 Formula: ~DBH2H.m3
 Parameter estimates:
    power
0.8954947

Coefficients:
                           Value   Std.Error  t-value p-value
(Intercept)           -0.0016886 0.002014040 -0.83839  0.4022
DBH2H.m3               0.3719938 0.004536861 81.99366  0.0000
DBH2H.m3.splinepoints -0.0003591 0.000065297 -5.49972  0.0000
```

Plot of Model 11



7.12 Model 12 –Volume with square of diameter at breast height * height (DBH2H) as predictor, with varConstPower

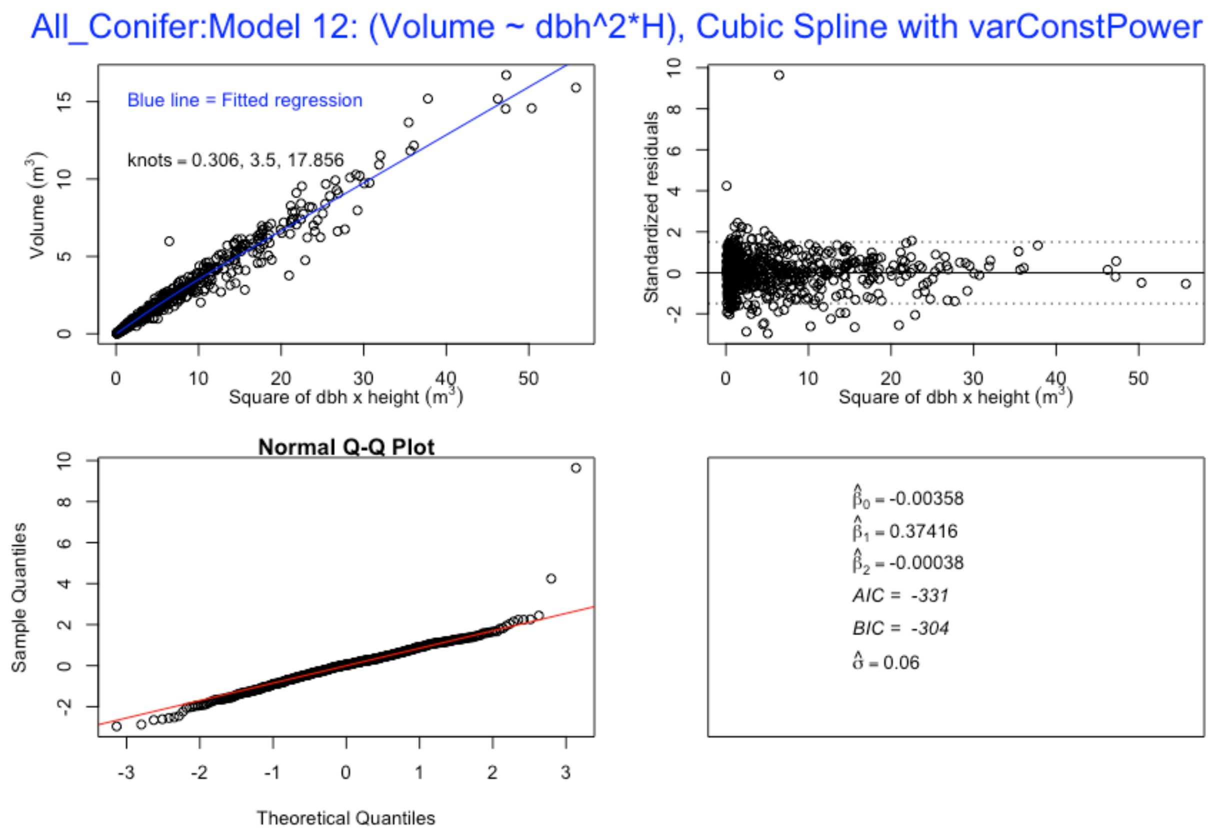
```
> allC.m12 <- gls(Volume.m3 ~ DBH2H.m3 + DBH2H.m3.splinepoints,
                  na.action=na.omit, weights = varConstPower(form =
                  ~DBH2H.m3))
> summary(allC.m12)

Generalized least squares fit by REML
  Model: Volume.m3 ~ DBH2H.m3 + DBH2H.m3.splinepoints
  Data: NULL
        AIC       BIC   logLik
  -330.6707 -304.4925 171.3353

Variance function:
 Structure: Constant plus power of variance covariate
 Formula: ~DBH2H.m3
 Parameter estimates:
    const     power
0.1207775 1.0220910

Coefficients:
                           Value   Std.Error  t-value p-value
(Intercept)           -0.0035830 0.002271096 -1.57765  0.1152
DBH2H.m3               0.3741577 0.004439735 84.27480  0.0000
DBH2H.m3.splinepoints -0.0003834 0.000069961 -5.48071  0.0000
```

Plot of Model 12



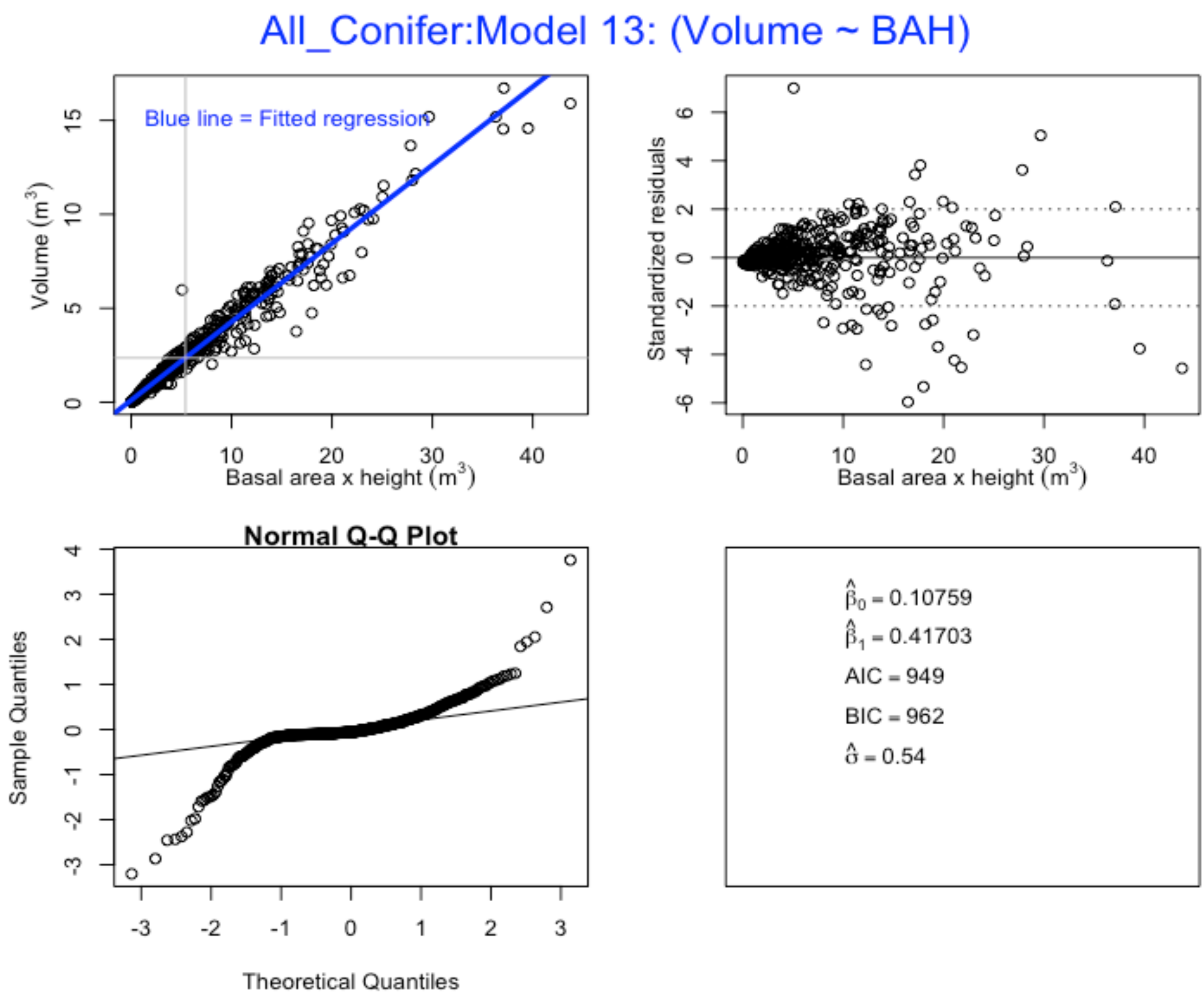
7.13 Model 13 – Volume with basal area * height (BAH) as predictor

```
> allC.m13 <- gls(Volume.m3 ~ BAH.m3)
> summary(allC.m13)

Generalized least squares fit by REML
  Model: Volume.m3 ~ BAH.m3
  Data: NULL
       AIC      BIC    logLik
  948.9536 962.0478 -471.4768

Coefficients:
                Value   Std.Error   t-value p-value
(Intercept) 0.1075947 0.028590006   3.76337   2e-04
BAH.m3      0.4170263 0.003321108 125.56845   0e+00
```

Plot of Model 13



7.14 Model 14 – Volume with basal area * height (BAH) as predictor, with varFixed

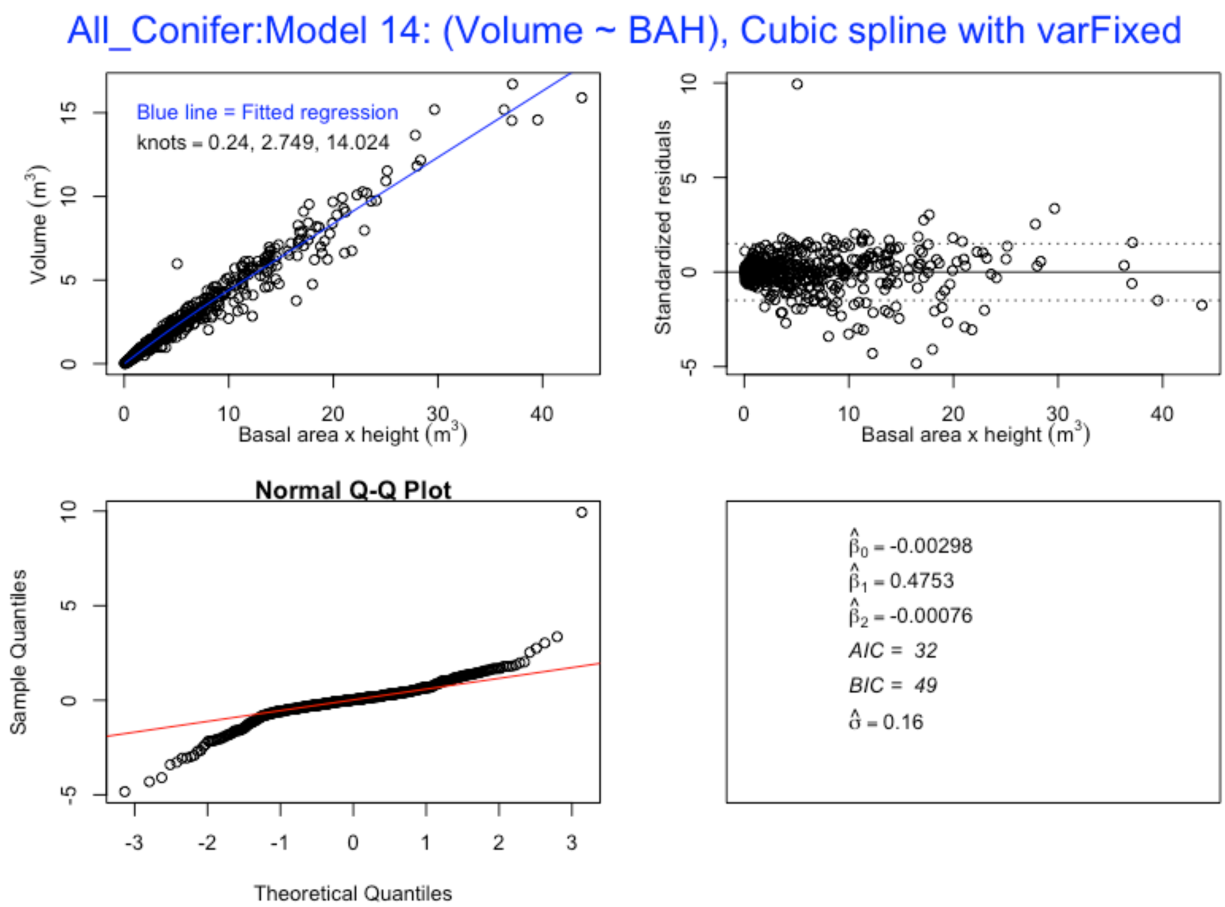
```
> allC.m14 <- gls(Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints,
              na.action=na.omit, weights = varFixed(~BAH.m3))
> summary(allC.m14)

Generalized least squares fit by REML
  Model: Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints
  Data: NULL
       AIC      BIC    logLik
  31.50594 48.95805 -11.75297

Variance function:
 Structure: fixed weights
 Formula: ~BAH.m3

Coefficients:
                         Value   Std.Error  t-value p-value
(Intercept)         -0.0029787 0.006757521 -0.44080  0.6595
BAH.m3               0.4752976 0.007358648 64.59034  0.0000
BAH.m3.splinepoints -0.0007600 0.000122918 -6.18287  0.0000
```

Plot of Model 14



7.15 Model 15– Volume with basal area * height (BAH) as predictor, with varPower

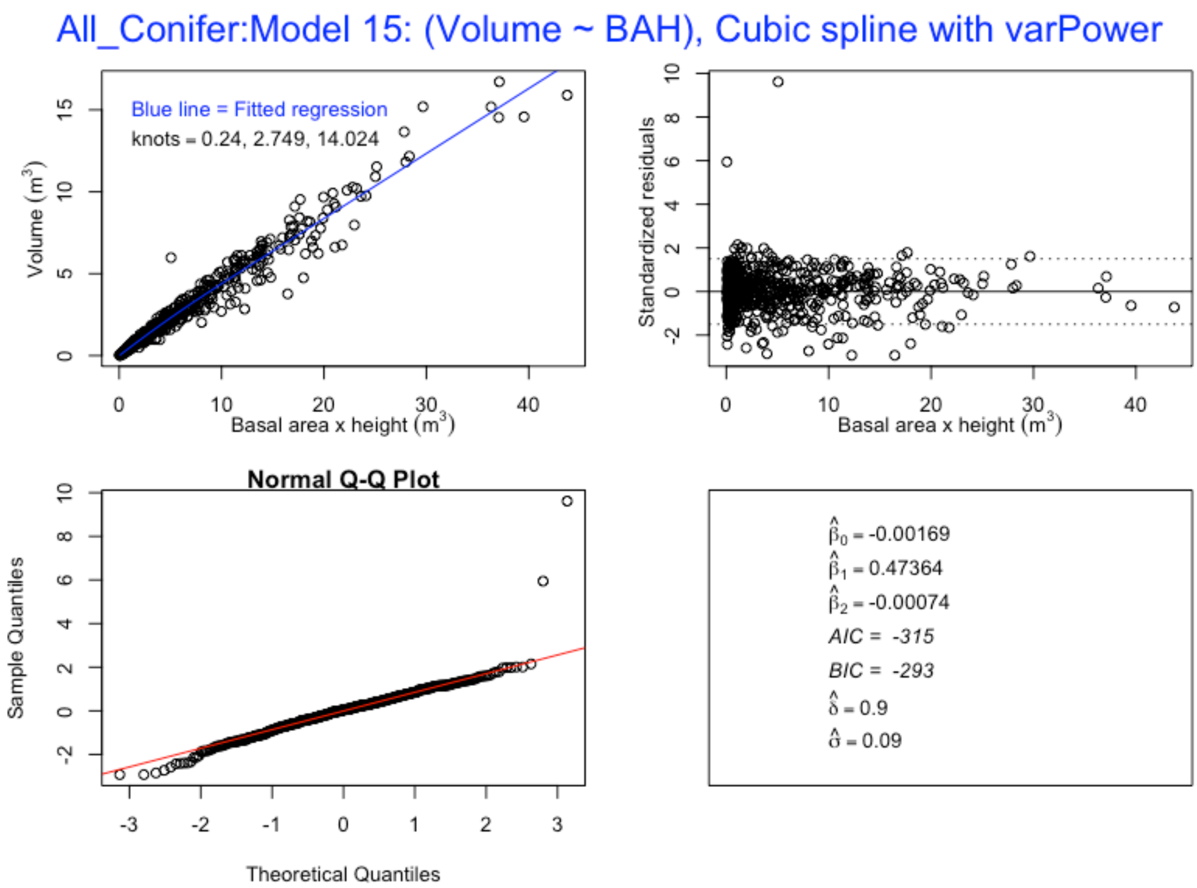
```
> allC.m15 <- gls(Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints,
                  na.action=na.omit, weights = varPower(form =
                  ~BAH.m3))
> summary(allC.m15)
```

```
Generalized least squares fit by REML
  Model: Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints
  Data: NULL
        AIC       BIC   logLik
  -315.1013 -293.2861 162.5506

Variance function:
 Structure: Power of variance covariate
 Formula: ~BAH.m3
 Parameter estimates:
    power
0.8954947

Coefficients:
                          Value   Std.Error  t-value p-value
(Intercept)          -0.0016886 0.002014040 -0.83839  0.4022
BAH.m3                0.4736373 0.005776511 81.99366  0.0000
BAH.m3.splinepoints  -0.0007412 0.000134779 -5.49972  0.0000
```

Plot of Model 15



7.16 Model 16 – Volume with basal area * height (BAH) as predictor, with varConstPower

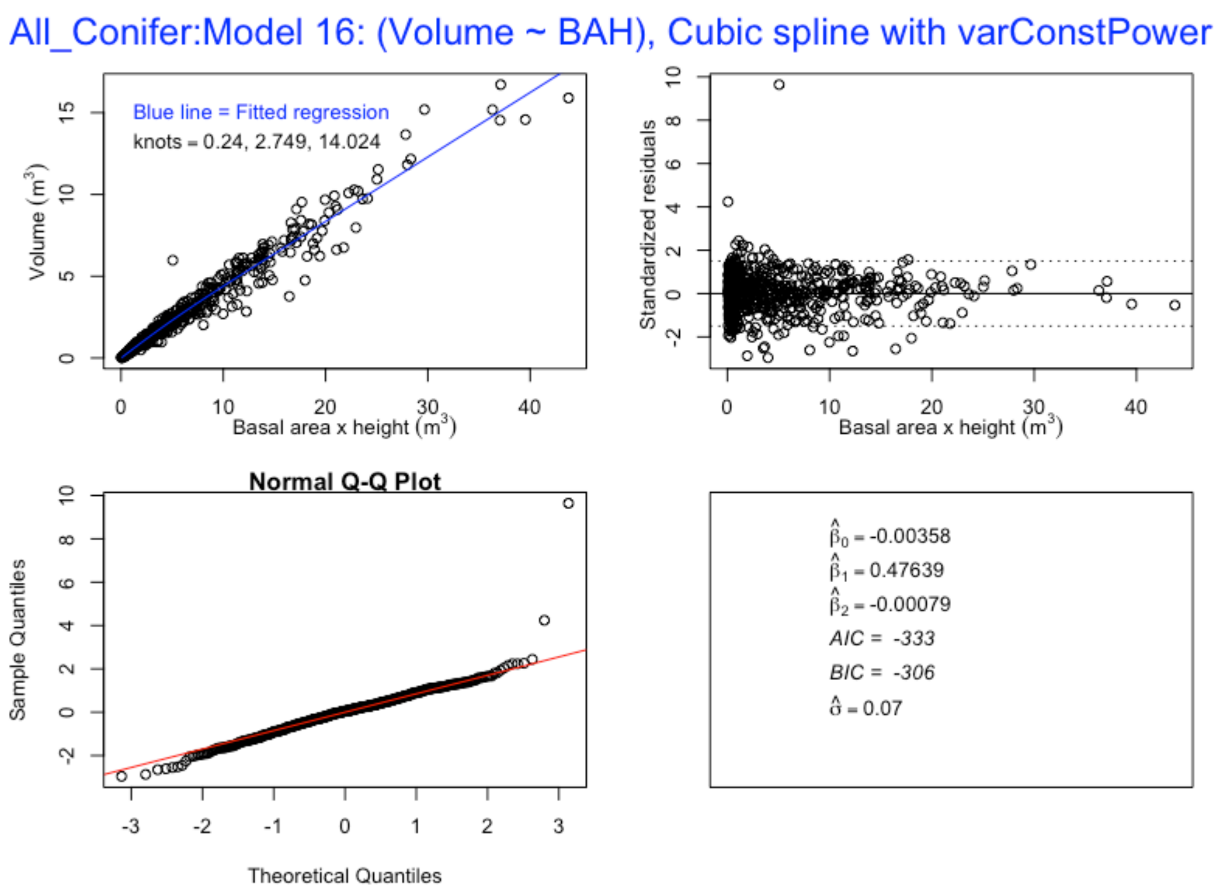
```
> allC.m16 <- gls(Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints,
                  na.action=na.omit, weights = varConstPower(form =
                  ~BAH.m3))
> summary(allC.m16)
```

```
Generalized least squares fit by REML
  Model: Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints
  Data: NULL
        AIC      BIC   logLik
  -332.6032 -306.425 172.3016

Variance function:
 Structure: Constant plus power of variance covariate
 Formula: ~BAH.m3
 Parameter estimates:
     const      power
0.09435356 1.02209099

Coefficients:
                         Value   Std.Error  t-value p-value
(Intercept)          -0.0035830 0.002271096 -1.57765  0.1152
BAH.m3                0.4763924 0.005652846 84.27480  0.0000
BAH.m3.splinepoints -0.0007914 0.000144405 -5.48071  0.0000
```

Plot of Model 16



8. Model evaluation using AIC and BIC values

SN	Model	AIC	BIC
1	Model 1 `> ps.m1 <- gls(Volume.m3 ~ DBH.cm)`	1924	1937
2	Model 2 `> ps.m2 <- gls(Volume.m3 ~ DBH.cm + DBH.cm.splinepoints, na.action=na.omit, weights = varFixed(~DBH.cm))`	1390	1407
3	Model 3 `> ps.m3 <- gls(Volume.m3 ~ DBH.cm + DBH.cm.splinepoints, na.action=na.omit, weights = varPower(form = ~DBH.cm))`	595	617
4	Model 4 `> ps.m4 <- gls(Volume.m3 ~ DBH.cm + DBH.cm.splinepoints, na.action=na.omit, weights = varConstPower(form = ~DBH.cm))`	596	622
5	Model 5 `> ps.m5 <- gls(Volume.m3 ~ BA.m2)`	1809	1822
6	Model 6 `> ps.m6<- gls(Volume.m3 ~ BA.m2 + BA.m2.splinepoints, na.action=na.omit, weights = varFixed(~BA.m2))`	1051	1068
7	Model 7 `> ps.m7 <- gls(Volume.m3 ~ BA.m2 + BA.m2.splinepoints, na.action=na.omit, weights = varPower(form = ~BA.m2))`	546	568
8	Model 8 `> ps.m8 <- gls(Volume.m3 ~ BA.m2 + BA.m2.splinepoints, na.action=na.omit, weights = varConstPower(form = ~BA.m2))`	546	573
9	Model 9 `> ps.m9 <- gls(Volume.m3 ~ DBH2H.m3)`	949	963
10	Model 10	33	51

	`> ps.m10 <-gls(Volume.m3 ~ DBH2H.m3 + DBH2H.m3.splinepoints, na.action=na.omit, weights = varFixed(~DBH2H.m3))`		
11	Model 11 `> ps.m11 <-gls(Volume.m3 ~ DBH2H.m3 + DBH2H.m3.splinepoints, na.action=na.omit, weights = varPower(form = ~DBH2H.m3))`	-313	-291
12	Model 12 `> ps.m12 <- gls(Volume.m3 ~ DBH2H.m3 + DBH2H.m3.splinepoints, na.action=na.omit, weights = varConstPower(form = ~DBH2H.m3))`	-331	-304
13	Model 13 `> ps.m13 <- gls(Volume.m3 ~ BAH.m3)`	949	962
14	Model 14 `> ps.m14 <- gls(Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints, na.action=na.omit, weights = varFixed(~BAH.m3))`	32	49
15	Model 15 `> ps.m15 <- gls(Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints, na.action=na.omit, weights = varPower(form = ~BAH.m3))`	-315	-293
16	Model 16 `> ps.m16 <- gls(Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints, na.action=na.omit, weights = varConstPower(form = ~BAH.m3))`	-333	-306

9. Selected Models

The best fitting models have been selected based on Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values of the fitted models. The BIC value was mainly relied upon as it imposes a stronger penalty for the number of parameters in the model that need to be estimated. Smaller the values of AIC and BIC, better the fit of the model. Therefore, for *Conifer*, the selected models are;

1. Model 7 (Model which doesn't use height)
```
ps.m7 <- gls(Volume.m3 ~ BA.m2 + BA.m2.splinepoints,
             na.action=na.omit, weights =  varPower(form = ~BA.m2))
```

2. Model 16 (Model which uses the height)
```
ps.m16 <- gls(Volume.m3 ~ BAH.m3 + BAH.m3.splinepoints,
              na.action=na.omit, weights = varConstPower(form = ~BAH.m3))
```

Two models have been selected for *Conifer*, one without height (X_1= BA which is model 7) and one with the height (X_1 = BAH, which is Model 16) as predictor or explanatory variable. Both the models have been fitted with natural (restricted) cubic spline function within a linear model framework. Although, nonlinear models are more flexible, they are more complicated than the linear models. The complications involved and amount of time and efforts spent on fitting nonlinear models often fail to justify by the improvements in the models. Moreover, the models fitted with natural (restricted) cubic spline functions perform well and track the curvilinearity better than nonlinear functions that were examined.

10. Demonstration of use of the selected best fit model

In general, the natural spline predictor with knots represented by t1, t2 and t3 takes the following form;

$$Y = \beta_0 + \beta_1 X + \beta_2 X_s + \varepsilon \qquad (7)$$

Where X_S corresponds to value in X as follows:

$$\text{Xs} = \text{g(X)} = (X - t1)_+^3 - (X - t2)_+^3 \frac{(t3-t1)}{(t3-t2)} + (X - t3)_+^3 \frac{(t2-t1)}{(t3-t2)} \qquad (8)$$

and the value of the positive part functions depend on the values of the knots as follows;

$$(X - t1)_+^3 = (X - t1)_+^3, \text{ if X > t1 and } (X - t1)_+^3 = 0, \text{ if X<t1} \qquad (9)$$

$$(X - t2)_+^3 = (X - t2)_+^3, \text{ if X> t2, and } (X - t2)_+^3 = 0, \text{ if X < t2} \qquad (10)$$

$$(X - t3)_+^3 = (X - t3)_+^3, \text{ if X > t3, and } (X - t3)_+^3 = 0, \text{ if X<t3} \qquad (11)$$

Where t1, t2 and t3 for the above models are 10^{th}, 50^{th} and 90^{th} percentiles and are called knots. The values of knots differ from species and models.

To demonstrate use of the selected models for *Conifer* – model 7, the knots t1, t2 and t3 are 0.022, 0.113 and 0.408 as generated by the model. The model 7 has been fitted with volume as function of basal area in meter square (BA) i.e

$$BA = \pi r^2 \tag{12}$$

where in

$$r^2 = \left[\frac{dbh}{2*100}\right]^2 \tag{13}$$

Where r is radius in meters and dbh is diameter at breast height in centimeters.

Therefore, *Conifer* with diameter of 37 cm resulting in basal area of 0.107521 m^2, the volume can be estimated using the above equation (model 7) as below. But first the value of BA.m2 has to be calculated, which is;

$$BA \quad = \pi r^2 = \frac{\pi * 37^2}{200^2} = 0.107521 \text{ m}^2$$

$$g(X) \quad = (X - t1)_+^3 - (X - t2)_+^3 \frac{(t3 - t1)}{(t3 - t2)} + (X - t3)_+^3 \frac{(t2 - t1)}{(t3 - t2)}$$

$$g(BA) \quad = (BA - t1)_+^3 - (BA - t2)_+^3 \frac{(t3 - t1)}{(t3 - t2)} + (BA - t3)_+^3 \frac{(t2 - t1)}{(t3 - t2)}$$

$$g(BA) \quad = (0.107521 \ - 0.022)_+^3 - 0 + 0$$

$$= (0.085521)_+^3 - 0 + 0$$

$$= (0.240397101)_+^3$$

$$= 0.000625487$$

Hence, the volume predicted for this tree by the selected model (model 7) is

$$V = \beta_0 + \beta_1 . BA + \beta_2 BA . m_2 + \varepsilon$$

$$= -0.07931 + 10.11634 * 0.107521 + 97.61931 * 0.000625487$$

$$= -0.07931 + 1.087719 + 0.0610596$$

$$= \mathbf{1.069468 \ m^3}$$

Similarly, to demonstrate model 16 with t1, t2 and t3 of 0.24, 2.749 and 14.024 respectively, we considered this same tree but with height, i.e dbh = 37 cm resulting in BA = 0.107521 m^2 and height (H) = 22.6 m.

$$BAH = 0.107521 \text{ x } 22.6$$

$$= 2.429974794$$

$$g(X) = (X - t1)_+^3 - (X - t2)_+^3 \frac{(t3 - t1)}{(t3 - t2)} + (X - t3)_+^3 \frac{(t2 - t1)}{(t3 - t2)}$$

$$g(BAH) = (BAH - t1)_+^3 - (BAH - t2)_+^3 \frac{(t3 - t1)}{(t3 - t2)} + (BAH - t3)_+^3 \frac{(t2 - t1)}{(t3 - t2)}$$

$$= (2.429974794 - 0.24)_+^3 - 0 + 0$$

$$= (2.189974794)_+^3$$

$$= 10.503096$$

Hence, the volume predicted by model 15 for this tree is;

$$V = \beta_0 + \beta_1 . BAH.m3 + \beta_2 BAH.m3_2 + \varepsilon$$

$$= -0.0016886 + 0.47363738 * 2.429974794 + (-0.0007412 * 10.503096)$$

$$= -0.0016886 + 1.1509267 + (-0.007784895)$$

= **1.141453205 m^3**

However, the field measured volume for this particular tree with DBH of 37 cm and height of 22.6 m is 1.4419409 m^3.

11. Model Performance

To assess the performance of selected models, we compared the volume predicted by selected models (7 and 16) with the volume of the tree as measured in the field. Using the equations of the selected models, volume prediction or estimation was done in R.

SN	Tree_ ID	Height (in m)	DBH (in cm)	Volume in m3 (Field measured) [A]	Predicted Volume Model_7 [B]	Predicted Volume Model_16 [C]	Difference (Field - Model_7)	Difference (Field – Model_16)
1	prwc01	22.6	37	1.4419409	1.069468711	1.141453205	0.372472198	0.300487704
2	prwc02	24.5	46	2.4420904	1.875351715	1.887202494	0.566738721	0.554887943
3	prwc03	21.6	26.6	0.7157319	0.486565156	0.566184158	0.229166786	0.149547785
4	prwc04	26.7	55.4	3.4615176	3.117110945	2.915779736	0.344406608	0.545737817
5	prwc05	13.5	19	0.2085542	0.207542339	0.179600454	0.001011868	0.028953754
6	prwc07	25.6	75.5	5.3786707	7.193229408	4.978647215	-1.814558715	0.400023478
7	prwc08	30.5	68.5	5.766943	5.57979262	4.89022059	0.187150337	0.876722367
8	pre01	37.47	77.8	7.7445871	7.758243915	7.501409422	-0.013656865	0.243177628
9	pre02	36.9	57.4	4.17151	3.438581342	4.207910968	0.732928663	-0.036400963
10	pre04	39.4	62	5.3299339	4.254606106	5.152057978	1.075327812	0.177875939
11	pre05	23.94	32.5	1.0364244	0.782029751	0.935013099	0.254394641	0.101411293
12	pre06	37.1	68.5	5.5219342	5.57979262	5.858748562	-0.057858457	-0.336814399
13	pre07	27.9	47.8	2.4487711	2.079636721	2.299813971	0.36913438	0.14895713
14	pre08	36.8	59.8	4.8874486	3.85113406	4.526689932	1.036314523	0.360758651
15	pre09	29.4	39.7	2.0184571	1.275732336	1.693546323	0.742724727	0.32491074
16	pre10	40.41	67.4	6.1748332	5.342432349	6.154474446	0.832400884	0.020358787
17	pre11	37.63	76.2	7.052333	7.36339558	7.242673367	-0.311062536	-0.190340323
18	pre13	13.16	19.2	0.1928686	0.213620374	0.178774795	-0.020751799	0.01409378
19	pre15	21.18	27.8	0.6329668	0.540396314	0.606371616	0.09257045	0.026595147
20	pre16	23.1	52.2	2.6978027	2.645065891	2.272229589	0.052736798	0.4255731
21	pre17	25.8	40.9	1.533572	1.37675782	1.58085996	0.156814211	-0.047287929
22	pre18	19.9	23	0.3804039	0.341728416	0.389763301	0.038675519	-0.009359366
23	pre20	34.79	73	6.4114296	6.598312831	6.211277702	-0.186883186	0.200151944
24	pre21	31.12	50	2.935316	2.350432697	2.776892083	0.584883342	0.158423956
25	pre22	27.8	36.2	1.4638907	1.013609715	1.340145995	0.450280961	0.12374468
26	pre23	41.9	65.3	5.7679438	4.903589979	6.001556881	0.864353792	-0.23361311
27	pre24	28.65	54.6	2.8623054	2.994226718	3.031181684	-0.131921271	-0.168876237
28	pre28	13.99	16.8	0.1721478	0.144939696	0.145194321	0.027208057	0.026953432
29	pre29	19.8	27.4	0.6557213	0.522125974	0.550690676	0.133595359	0.105030657
30	pre31	28.83	34.4	1.503784	0.895763327	1.256655228	0.608020706	0.247128805
31	pre33	24.9	46	1.6600825	1.875351715	1.916812297	-0.215269251	-0.256729833
32	pre34	10.85	14.1	0.082489	0.0786516	0.078553769	0.003837412	0.003935243
33	pre35	17.86	29.1	0.6003979	0.602117733	0.560284754	-0.001719835	0.040113145
34	prec01	25.1	31.5	0.9073533	0.726148178	0.921034018	0.18120514	-0.0136807
35	prec02	34.7	64.4	5.1292912	4.721537654	4.915376484	0.407753535	0.213914706
36	prec03	26.1	28.5	0.8223677	0.573177951	0.784783297	0.249189776	0.03758443

37	prec04	17.65	15	0.1287263	0.099460484	0.146039188	0.029265857	-0.017312847
38	prec05	33.65	44.3	2.3697177	1.696271888	2.378288158	0.673445763	-0.008570507
39	prec07	37.32	75.3	8.2710288	7.144898946	7.028028104	1.126129838	1.24300068
40	prec08	37.8	54	3.4095787	2.90420011	3.84347893	0.505378579	-0.43390024
41	jre01	17.05	24	0.4176936	0.379567576	0.363527959	0.038126047	0.054165664
42	jre02	14.95	37.3	0.7084998	1.091005942	0.770044525	-0.382506164	-0.061544747
43	jre03	21.4	54	2.0509837	2.90420011	2.253616675	-0.853216413	-0.202632977
44	jre04	24.1	47.5	1.7869689	2.044522517	1.975708171	-0.257553654	-0.188739308
45	jre05	26.9	63	2.7651528	4.445827262	3.7316363	-1.680674496	-0.966483534
46	jre06	28.9	71.6	4.1461039	6.273913668	5.04870151	-2.127809805	-0.902597647
47	jre08	10.3	13	0.0700503	0.054966497	0.063064372	0.015083841	0.006985966
48	jrec01	16.5	26.8	0.4736461	0.495334632	0.438915533	-0.021688535	0.034730564
49	jrec02	20.3	44.4	1.5147972	1.706440885	1.468900213	-0.191643665	0.045897007
50	jrec03	21.7	39	1.1294322	1.2195095	1.216456193	-0.090077287	-0.08702398
51	jrec04	18.75	32	0.6186337	0.753762583	0.711028649	-0.135128839	-0.092394905
52	jrec06	23	42	1.537157	1.474649914	1.488679747	0.06250706	0.048477226
53	jrec07	21.35	36	1.093081	0.999992036	1.022248757	0.093088985	0.070832265
54	jrec08	13.95	15.2	0.1186772	0.104259479	0.118205319	0.01441776	0.00047192
55	jrec09	22.5	47	1.5907203	1.986951971	1.812161161	-0.396231689	-0.221440879
56	jrec10	22.6	61.5	2.4195878	4.160813987	3.033462347	-1.741226189	-0.613874549
57	jrec11	10.95	18	0.1173633	0.178123495	0.130287341	-0.060760196	-0.012924042
58	jrec12	21.1	57.7	2.2635794	3.488557125	2.521783706	-1.224977764	-0.258204345
59	jrec13	21.4	50.5	1.9742079	2.415281406	1.982668697	-0.441073483	-0.008460774
60	jrec14	22.42	27.3	0.6704866	0.517609944	0.61897689	0.15287663	0.051509683
61	jrec17	7.38	12.4	0.0418182	0.042857776	0.040523359	-0.001039531	0.001294886
62	jrec19	19.4	54	1.7866075	2.90420011	2.05206777	-1.117592627	-0.265460286
63	jrec20	8	14.3	0.0710233	0.083164561	0.05916662	-0.012141222	0.011856719
64	jrec21	9.6	18.4	0.1185622	0.189697377	0.119215951	-0.071135216	-0.00065379
65	jrec22	8.95	10.3	0.0333206	0.00498227	0.033632422	0.028338311	-0.000311841
66	jrec23	11.15	20.6	0.1810718	0.258001026	0.174322848	-0.07692924	0.006748938
67	jrec24	20.45	41.2	1.2307215	1.40294809	1.278208372	-0.172226591	-0.047486873
68	jrec25	20.94	38	1.1266602	1.142564772	1.11591108	-0.015904551	0.010749141
69	jrec26	19.31	30	0.6532052	0.647037259	0.643744357	0.006167983	0.009460885
70	jrec27	15	45.3	1.0230076	1.800006576	1.135705472	-0.776998982	-0.112697878
71	jrec28	21.66	68.8	2.024215	5.645379283	3.593972096	-3.62116431	-1.569757123
72	jrec29	15.78	20.8	0.3016961	0.264605654	0.252254553	0.037090438	0.049441538
73	jrec30	16.2	29.4	0.6119248	0.616886513	0.518729664	-0.004961743	0.093195106
74	jrec31	19.11	58	2.3776238	3.538989645	2.318304376	-1.161365838	0.059319431
75	jrec32	22.58	66.3	2.7788469	5.110157725	3.487297608	-2.331310791	-0.708450674
76	jrwc01	32.4	85	8.1972004	9.636593854	7.728565471	-1.4393935	0.468634882
77	jrwc02	25.6	53.5	2.44738	2.830574226	2.624332828	-0.383194259	-0.17695286
78	jrwc03	24.4	38	1.4322951	1.142564772	1.297015747	0.289730321	0.135279346
79	jrwc04	28.6	66	5.0876991	5.047721069	4.303761984	0.039978049	0.783937135
80	jrwc05	24.6	46	2.0732627	1.875351715	1.894609014	0.19791096	0.178653662
81	jrwc06	19.9	29	0.5903002	0.597239456	0.619957275	-0.006939267	-0.029657086

82	jrwc08	9.6	18.6	0.1479604	0.195580999	0.121858591	-0.047620639	0.02610177
83	jrw01	28.3	78.8	5.99244	8.009190544	5.910001373	-2.016750564	0.082438607
84	jrw02	16.83	27.6	0.5626483	0.531219716	0.47488886	0.031428602	0.087759459
85	jrw03	11.15	18.5	0.1796373	0.192631116	0.140267356	-0.012993797	0.039369964
86	jrw04	16	33.5	0.6745473	0.840603262	0.665075675	-0.166055991	0.009471597
87	jrw05	17.6	44.6	1.1557403	1.72691458	1.288917336	-0.571174309	-0.133177065
88	jrw06	24.28	64.5	3.9575726	4.741582091	3.544609306	-0.784009537	0.412963249
89	jrw08	18.05	56.6	2.5720257	3.307549262	2.095564642	-0.73552357	0.476461051
90	pwec01	10.9	14.5	0.0781127	0.087741086	0.083562164	-0.009628366	-0.005449444
91	pwec02	33.33	37	1.8694462	1.069468711	1.668492417	0.799977439	0.200953733
92	pwec03	25.2	27	0.8227457	0.504184138	0.680403984	0.31856157	0.142341724
93	pwec04	35.2	69.8	4.5659073	5.866539252	5.778128095	-1.300631945	-1.212220787
94	pwec05	26.5	28.5	0.9018238	0.573177951	0.796752079	0.328645887	0.105071759
95	pwec07	13.2	12	0.0495945	0.03510311	0.069019994	0.01449141	-0.019425474
96	pwec09	8.5	10	0.0212528	0.000143549	0.029930879	0.021109264	-0.008678066
97	pwec10	34.65	71.7	6.7192179	6.296874695	5.984932222	0.422343209	0.734285682
98	pwec11	37.2	65.8	5.6401109	5.006317523	5.452634044	0.633793362	0.187476842
99	pwec12	33.3	57.2	4.5990748	3.405518163	3.802376314	1.193556655	0.796698505
100	pwec13	27.82	40	1.4669552	1.300434029	1.628923802	0.166521154	-0.161968619
101	pwec14	31.7	73.5	6.3254235	6.715693678	5.770507079	-0.390270144	0.554916454
102	pwec15	16.25	15.3	0.1461486	0.106682812	0.139816321	0.039465775	0.006332266
103	pwec16	26.56	60.6	3.9077158	3.995081325	3.431158073	-0.087365478	0.476557773
104	pwec18	31.53	62.7	4.2773877	4.387955249	4.283749174	-0.110567552	-0.006361477
105	pwec19	51.5	95.8	16.714009	12.76563871	15.16194874	3.948369929	1.552059907
106	pwec20	28.1	30.3	0.8992882	0.662425726	0.953769424	0.236862492	-0.054481207
107	pwec21	32.55	55.7	4.372989	3.164032792	3.543800116	1.208956255	0.829188931
108	pwec22	17.92	21.9	0.3210929	0.30213267	0.317964646	0.018960263	0.003128287
109	pwec23	11.28	17	0.1184639	0.150310789	0.119578421	-0.031846889	-0.001114522
110	pwec24	18.82	31.3	0.7404164	0.715280918	0.682878076	0.025135518	0.057538359
111	pwec25	46.81	71.2	8.1618112	6.182404758	7.828602904	1.979406395	0.333208249
112	pwec29	23.69	35.6	1.1575019	0.973160021	1.108133911	0.184341835	0.049367945
113	pwec30	26.51	24.1	0.634743	0.383450016	0.570405506	0.251293003	0.064337513
114	pwec31	25.85	42.5	2.2701542	1.520855699	1.706074712	0.749298494	0.564079481
115	pwec32	15.27	13.3	0.07656	0.061235382	0.098791046	0.015324569	-0.022231095
116	pwec35	30.3	47.6	2.9411056	2.056179451	2.4675155	0.884926155	0.473590107
117	pwec36	34.54	66.7	5.7797154	5.194018935	5.22131224	0.585696424	0.55840312
118	pwwc01	61.3	78.5	15.191059	7.933570037	12.20482487	7.257488754	2.986233921
119	pwwc02	50.5	65.5	7.8843696	4.944546371	7.185379853	2.939823213	0.698989731
120	pwwc03	47.4	49	3.9978153	2.224424279	3.958915077	1.773391026	0.038900228
121	pwwc04	25.6	35.8	1.2948028	0.986509414	1.209363567	0.308293343	0.085439189
122	pwwc05	43.4	57.5	5.890892	3.455189153	4.902099757	2.435702848	0.988792244
123	pwwc06	20.5	28	0.6260113	0.549656521	0.595388059	0.07635476	0.030623222
124	pwwc07	15.5	19.4	0.1880146	0.219763542	0.215309301	-0.031748988	-0.027294747
125	pww01	40.4	68.2	7.1140652	5.51456671	6.289618701	1.599498482	0.824446492
126	pww02	32.3	46.7	2.5165087	1.952978303	2.528397993	0.56353036	-0.01188933

127	pww03	34.3	59.8	4.3243179	3.85113406	4.242436899	0.473183846	0.081881006
128	pww04	29.7	29.5	1.0017944	0.621854469	0.95553171	0.379939923	0.046262682
129	pww05	20.6	16.9	0.2205563	0.147617288	0.217168326	0.072938981	0.003387943
130	pww06	25.6	35.2	1.1588433	0.94685378	1.169797843	0.211989533	-0.010954529
131	pww07	46.7	79.5	10.209367	8.186760122	9.631346729	2.02260647	0.578019863
132	pww09	30	54	3.6809078	2.90420011	3.099884924	0.776707672	0.581022858
133	pww10	35	79	9.1035513	8.059764462	7.240762125	1.043786824	1.862789161
134	pww11	24	37.2	1.0944266	1.083790266	1.223935495	0.010636324	-0.129508905
135	pww12	29	49.5	2.5787317	2.286815983	2.549257822	0.291915752	0.029473914
136	pww13	31	45.6	5.9775094	1.832019774	2.324274117	4.145489597	3.653235255
137	pww14	37	75.5	6.4558554	7.193229408	7.006262858	-0.737374045	-0.550407495
138	pww15	32.2	59.8	3.7148191	3.85113406	4.00202304	-0.13631496	-0.287203941
139	pww16	31.3	51.4	2.8614882	2.535134161	2.940707052	0.326354057	-0.079218835
140	pww17	32.4	58.9	3.5459117	3.693020852	3.913692944	-0.147109142	-0.367781235
141	pww18	31.6	51.8	2.8667733	2.589699044	3.01056952	0.277074288	-0.143796188
142	pww19	29.7	44.7	2.5324821	1.737219454	2.148138104	0.795262672	0.384344022
143	pww20	31.2	46.4	2.3313343	1.919428644	2.417049654	0.411905608	-0.085715402
144	pww21	24.6	53.3	2.5446452	2.801478671	2.50947824	-0.256833465	0.035166966
145	pww22	24.3	56.8	2.4841157	3.340002018	2.796959937	-0.855886317	-0.312844236
146	pww23	23.4	63.8	2.8262222	4.6022473	3.356109747	-1.776025145	-0.529887592
147	pww24	25	42.3	0.980704	1.502243785	1.63673387	-0.521539753	-0.656029838
148	pww25	25	38.7	0.9701842	1.196013168	1.376546005	-0.22582892	-0.406361758
149	pww26	21	47	1.0336279	1.986951971	1.695382843	-0.953324102	-0.661754974
150	pww27	23	57	2.0463563	3.37265835	2.673429286	-1.326302099	-0.627073035
151	pww28	23	56.8	2.7597478	3.340002018	2.655758107	-0.580254188	0.103989722
152	pww29	23	43.8	1.747233	1.646101815	1.615161989	0.101131152	0.132070978
153	pww30	26	48.4	2.333366	2.151160727	2.20210614	0.182205238	0.131259825
154	pww31	25	57.2	2.9081685	3.405518163	2.910750533	-0.497349701	-0.002582071
155	pww32	26	57.2	2.8687851	3.405518163	3.019798023	-0.536733049	-0.151012909
156	pww33	26	58.5	2.8478173	3.624057067	3.149508728	-0.776239734	-0.301691396
157	pww34	22	70	2.9182803	5.911227514	3.765111367	-2.992947231	-0.846831085
158	pww35	21	39	0.8502651	1.2195095	1.177842698	-0.369244404	-0.327577602
159	pww36	14	40.2	0.8807492	1.317106029	0.837240259	-0.436356831	0.043508939
160	pww37	23	50	1.5400811	2.350432697	2.084324755	-0.810351637	-0.544243695
161	pww38	25	56	2.2448671	3.211413146	2.797039418	-0.966546056	-0.552172327
162	pww39	14	30	0.452232	0.647037259	0.466711475	-0.194805235	-0.014479451
163	pww40	13.5	24.6	0.3100358	0.403135315	0.302169716	-0.093099526	0.007866073
164	pww41	12	27	0.338292	0.504184138	0.323665404	-0.165892156	0.014626578
165	pww42	42	53	2.9435934	2.758214872	4.092796959	0.185378521	-1.149203566
166	pww43	47	49	3.1556708	2.224424279	3.928009714	0.931246496	-0.77233894
167	pww44	47	52	2.7005417	2.617282066	4.383530944	0.083259603	-1.682989275
168	pww45	7	20	0.0944591	0.238585688	0.102469682	-0.144126638	-0.008010632
169	pww46	9.5	18.7	0.1093018	0.198547044	0.121889801	-0.089245214	-0.012587971
170	pww47	13	28	0.382067	0.549656521	0.377317048	-0.167589563	0.00474991
171	pww48	7	20.9	0.0664561	0.267933011	0.112054848	-0.201476952	-0.045598789

172	pww49	8.7	16	0.0748731	0.124091084	0.081161874	-0.049217941	-0.006288731
173	pww50	6.6	17	0.0622336	0.150310789	0.06926551	-0.088077166	-0.007031887
174	pww51	8	17.6	0.071559	0.166806544	0.090494456	-0.095247514	-0.018935426
175	pww52	8.2	15	0.0639511	0.099460484	0.066944268	-0.03550936	-0.002993144
176	pww53	11	22.3	0.1925715	0.316289001	0.201794058	-0.123717511	-0.009222568
177	pww54	13	21.7	0.1933463	0.295157201	0.226019701	-0.101810916	-0.032673416
178	pww55	8	17	0.0970202	0.150310789	0.084316382	-0.053290598	0.012703809
179	pww56	6.4	19.6	0.0952932	0.225972024	0.089770705	-0.130678833	0.005522486
180	pww57	11	24.8	0.2118247	0.411137981	0.249963286	-0.199313267	-0.038138572
181	pww58	9	17	0.1066996	0.150310789	0.095067004	-0.043611234	0.011632551
182	pww59	11	22	0.2001901	0.30564602	0.196356744	-0.105455948	0.003833328
183	pww60	6	12	0.0383451	0.03510311	0.03045167	0.003241942	0.007893382
184	pww61	8	19.6	0.1317152	0.225972024	0.112635531	-0.094256874	0.019079619
185	pww62	8.5	17	0.0829881	0.150310789	0.089691693	-0.067322708	-0.006703613
186	pww63	10	15.5	0.0994442	0.11157715	0.087682926	-0.012132958	0.011761266
187	pww64	10.3	20	0.156791	0.238585688	0.15157244	-0.081794694	0.005218554
188	pww65	13	29	0.3317293	0.597239456	0.404836774	-0.265510113	-0.073107431
189	pww66	7.5	13	0.0610022	0.054966497	0.045461622	0.006035696	0.015540571
190	pww67	9.2	22.8	0.2052339	0.334372892	0.176216659	-0.12913896	0.029017274
191	pww68	12.3	21.4	0.235203	0.284821511	0.207845976	-0.049618516	0.027357019
192	pww69	16	28	0.6041729	0.549656521	0.464633772	0.054516335	0.139539083
193	pww70	15.4	23	0.3480478	0.341728416	0.301312545	0.006319389	0.04673526
194	pww71	8.4	16	0.0797503	0.124091084	0.078304961	-0.044340776	0.001445348
195	pww72	10	16.3	0.1096801	0.131790133	0.09714645	-0.022110051	0.012533632
196	pww73	5.6	11.4	0.0293908	0.023947832	0.025384221	0.005442961	0.004006572
197	pww74	8.2	12	0.0416985	0.03510311	0.042236436	0.006595384	-0.000537942
198	pww75	10.4	23.3	0.2028284	0.352893531	0.208334979	-0.150065113	-0.005506561
199	pww76	4.6	17.5	0.0504156	0.164017337	0.050716036	-0.113601693	-0.000300392
200	pww77	9	21	0.1626726	0.271277106	0.145955492	-0.1086045	0.016717115
201	pww78	5.4	12	0.0248845	0.03510311	0.027237643	-0.01021861	-0.002353143
202	pww79	8.6	23	0.1841829	0.341728416	0.167545093	-0.157545515	0.016637809
203	pww80	5.6	16	0.0626739	0.124091084	0.051640441	-0.061417195	0.011033449
204	pww81	10	30	0.324308	0.647037259	0.333030458	-0.322729227	-0.008722427
205	pww82	9.3	17	0.0996593	0.150310789	0.098292191	-0.050651467	0.001367131
206	pww83	10.6	20.3	0.098011	0.248218847	0.160803237	-0.150207868	-0.062792259
207	pww84	8.2	17.6	0.0734222	0.166806544	0.092799032	-0.093384317	-0.019376805
208	pww86	10	23	0.1628252	0.341728416	0.19509215	-0.178903167	-0.032266901
209	pww87	6.4	16	0.0544474	0.124091084	0.059258875	-0.069643681	-0.004811471
210	pww88	9	17.9	0.1084972	0.17527021	0.105582899	-0.066773005	0.002914306
211	pww89	9.2	20	0.1290814	0.238585688	0.135205055	-0.109504292	-0.006123659
212	pww90	11.3	29.2	0.4517791	0.60701826	0.356618982	-0.155239181	0.095160097
213	pww91	11	16	0.0965776	0.124091084	0.103064873	-0.027513516	-0.006487304
214	pww92	15	22	0.2442875	0.30564602	0.268352262	-0.061358533	-0.024064775
215	pww93	16	23	0.3085072	0.341728416	0.313110205	-0.033221218	-0.004603007
216	pww94	13.4	22	0.1877977	0.30564602	0.239557253	-0.117848311	-0.051759544

217	pww95	9	16	0.0819609	0.124091084	0.084018787	-0.042130216	-0.002057918
218	pww96	12	26	0.2815675	0.460730394	0.300026406	-0.179162865	-0.018458877
219	pww97	10.5	16.2	0.1141644	0.129207893	0.100818774	-0.015043498	0.013345621
220	pww98	12	25	0.2359947	0.419214836	0.277275279	-0.18322009	-0.041280532
221	pww99	11.2	24.5	0.1762133	0.399161648	0.248377729	-0.222948302	-0.072164383
222	pww100	10.5	19.6	0.1246188	0.225972024	0.148361486	-0.101353274	-0.023742736
223	pww101	15.7	26	0.3613526	0.460730394	0.392960931	-0.09937782	-0.031608357
224	pww102	10.4	19.4	0.1403511	0.219763542	0.143914929	-0.079412411	-0.003563797
225	pww103	12	30	0.2965151	0.647037259	0.399897997	-0.350522192	-0.10338293
226	pww104	12.6	30.8	0.3499194	0.688548815	0.442697708	-0.338629374	-0.092778267
227	pww105	12.4	33	0.3933907	0.810969638	0.500227509	-0.417578938	-0.106836809
228	pww106	14	32	0.4559128	0.753762583	0.531086389	-0.297849812	-0.075173618
229	pww107	8.2	15	0.046179	0.099460484	0.066944268	-0.053281446	-0.02076523
230	pww108	15	42.3	0.8240479	1.502243785	0.991887762	-0.678195883	-0.16783986
231	pww109	12.4	21.3	0.1549642	0.281410139	0.207579977	-0.126445918	-0.052615757
232	pww110	10.5	17.3	0.0963578	0.158486859	0.115212146	-0.06212909	-0.018854377
233	pww111	14	21.4	0.2305702	0.284821511	0.236799466	-0.054251311	-0.006229266
234	pww112	9.3	13	0.0409268	0.054966497	0.056777676	-0.014039698	-0.015850877
235	pww113	21	83.6	6.1080119	9.258347096	5.005085499	-3.150335219	1.102926378
236	pww114	14	50	0.9714548	2.350432697	1.288584641	-1.378977927	-0.317129871
237	pww115	20	61	2.202325	4.068247029	2.663067508	-1.865922032	-0.460742511
238	pww116	21.3	54.6	1.5889236	2.994226718	2.29128976	-1.405303115	-0.702366158
239	pww117	17	43.7	1.1455847	1.636202148	1.196845802	-0.490617422	-0.051261076
240	pww118	21.2	53	1.7578025	2.758214872	2.155310384	-1.000412335	-0.397507848
241	pww119	19.3	60.4	1.7866667	3.958795808	2.52726843	-2.172129097	-0.740601719
242	pww120	18.8	51	1.4553825	2.481368616	1.78389918	-1.025986113	-0.328516677
243	pww121	16.3	31.3	0.4412572	0.715280918	0.591573211	-0.274023704	-0.150315997
244	pww122	16	26.3	0.2993302	0.473559559	0.409813866	-0.174229325	-0.110483632
245	pww123	14	22.3	0.2013058	0.316289001	0.257274357	-0.114983248	-0.055968604
246	pww124	15.8	34.5	0.6076515	0.902041328	0.696478192	-0.294389784	-0.088826648
247	pww125	16.6	28.3	0.378011	0.563705295	0.492483379	-0.185694276	-0.114472359
248	pww126	34	128	15.898068	24.31360645	17.79205289	-8.415538338	-1.89398477
249	pww127	29.3	94	8.9040979	12.21817124	8.501472813	-3.314073305	0.402625124
250	pww128	28.5	78.2	6.3966778	7.858237974	5.865039519	-1.461560221	0.531638234
251	pww129	24	58	2.5694728	3.538989645	2.875315984	-0.969516891	-0.305843229
252	pww130	23.4	46.2	1.4561983	1.897296735	1.820712258	-0.44109842	-0.364513944
253	pww131	16	23	0.2658943	0.341728416	0.313110205	-0.07583408	-0.047215869
254	pww132	25	64.2	3.6030074	4.681587794	3.61071807	-1.07858035	-0.007710626
255	pww133	23.3	47.5	1.8315817	2.044522517	1.912694743	-0.212940852	-0.081113079
256	pww134	22	44.5	1.632743	1.716655086	1.595325347	-0.083912077	0.037417662
257	pww135	24.7	62.5	3.4114406	4.349613974	3.396651741	-0.938173377	0.014788856
258	pww136	15	20	0.1897071	0.238585688	0.221498555	-0.048878624	-0.03179149
259	pww137	24.3	65.4	3.6716948	4.924045647	3.639782162	-1.252350821	0.031912664
260	pww138	26	55	2.7889476	3.055261562	2.805429032	-0.266313955	-0.016481425
261	pww139	25.6	78	5.7329307	7.808176846	5.28658765	-2.075246172	0.446343024

262	pww140	21	59	2.779737	3.710387895	2.618495273	-0.930650888	0.161241733
263	pww141	17.4	38.4	0.8413454	1.172872083	0.948602938	-0.331526667	-0.107257522
264	pww142	13	29.2	0.4147312	0.60701826	0.410455474	-0.192287099	0.004275686
265	pww143	24	84.5	6.0598413	9.500784615	5.77408175	-3.440943305	0.28575956
266	pww144	16	36	0.7414726	0.999992036	0.7676933	-0.258519423	-0.026220687
267	pww145	22.8	72.5	4.276918	6.481733219	4.152484433	-2.204815207	0.124433579
268	pww146	25.8	84.4	6.9119226	9.473718916	6.161010369	-2.561796325	0.750912221
269	pww147	11.3	17	0.1012156	0.150310789	0.119793433	-0.049095204	-0.018577849
270	pww148	13	19.9	0.1809404	0.235407623	0.189815389	-0.054467242	-0.008875008
271	pww149	17	42	1.1256522	1.474649914	1.106831699	-0.348997672	0.018820542
272	pww150	11	13.7	0.0614154	0.069816365	0.075112881	-0.008400988	-0.013697504
273	pww151	12	24.2	0.2659138	0.387350586	0.259714284	-0.121436821	0.006199481
274	pww152	14	23	0.2418894	0.341728416	0.273780494	-0.099838987	-0.031891065
275	pww153	9	18.3	0.104176	0.186779762	0.110430723	-0.082603786	-0.006254747
276	pww154	14	22	0.1992549	0.30564602	0.250355954	-0.106391157	-0.051101092
277	pww155	16	20.2	0.1761498	0.244991273	0.241157762	-0.068841512	-0.065008001
278	pww156	12.2	23.6	0.1759454	0.364218005	0.251059186	-0.188272618	-0.075113799
279	pww157	10	16	0.0744547	0.124091084	0.09354183	-0.049636425	-0.01908717
280	pww158	12	15.6	0.086466	0.114048156	0.106945513	-0.027582133	-0.02047949
281	pww159	14	24.1	0.2482681	0.383450016	0.300745307	-0.135181913	-0.052477204
282	pww160	11.2	16.5	0.1039305	0.137002286	0.111739769	-0.033071779	-0.007809263
283	pww161	12.2	25	0.2357228	0.419214836	0.281922467	-0.183492053	-0.046199684
284	pww162	13	24.4	0.2350891	0.395206344	0.286185848	-0.160117292	-0.051096795
285	pww163	16	40.7	0.7389101	1.359506911	0.979608575	-0.620596813	-0.240698476
286	pww164	13.6	23	0.2425719	0.341728416	0.265913212	-0.099156508	-0.023341304
287	pww165	13	24.7	0.2278997	0.407127406	0.293304445	-0.179227658	-0.065404697
288	pww166	11.3	25	0.1901788	0.419214836	0.26100897	-0.229036065	-0.070830199
289	pww167	14.2	26.2	0.3356695	0.469263671	0.360802887	-0.133594217	-0.025133433
290	pww168	16.1	27	0.3836567	0.504184138	0.434681953	-0.120527477	-0.051025292
291	pww169	12.4	22.4	0.1612146	0.319871108	0.22974804	-0.158656522	-0.068533453
292	pww170	12	20	0.1275302	0.238585688	0.17686655	-0.111055491	-0.049336353
293	pww171	15.2	20.9	0.201818	0.267933011	0.245280646	-0.066115046	-0.04346268
294	pww172	15	25.8	0.2686654	0.45227461	0.369612946	-0.183609224	-0.100947559
295	pww173	12	16.8	0.1091327	0.144939696	0.124301245	-0.035807033	-0.015168583
296	pww174	15.3	28.9	0.4406423	0.592383316	0.473341621	-0.151740993	-0.032699298
297	pww175	16	27.8	0.4157468	0.540396314	0.458008443	-0.12464952	-0.04226165
298	pww176	17.7	28.5	0.4744694	0.573177951	0.532599438	-0.098708526	-0.058130012
299	pww177	19.5	39.6	0.7710233	1.267579694	1.12834889	-0.496556383	-0.35732558
300	pww178	20.1	30.8	0.6155844	0.688548815	0.706142684	-0.072964375	-0.090558244
301	pww179	23.6	43	1.4892695	1.568147184	1.597844129	-0.078877683	-0.108574628
302	pww180	16.3	24	0.3463765	0.379567576	0.347477791	-0.033191036	-0.001101251
303	pww181	19	31.8	0.7503421	0.742639572	0.711529262	0.007702521	0.038812831
304	pww182	12	12.8	0.0641219	0.050866694	0.07144837	0.013255168	-0.007326508
305	pww183	11.3	14.7	0.0551348	0.092381173	0.089145494	-0.037246384	-0.034010705
306	pww184	10.5	11	0.0181333	0.016828794	0.045573221	0.001304471	-0.027439956

307	pww185	12	18.9	0.1560724	0.204527694	0.157766645	-0.048455329	-0.00169428
308	pww186	17.5	20.1	0.3025066	0.241780229	0.261294342	0.060726389	0.041212277
309	pww187	15.2	20	0.2119353	0.238585688	0.224473738	-0.026650407	-0.012538457
310	pww188	16.7	19.3	0.1758799	0.216683805	0.229701889	-0.040803888	-0.053821972
311	pww189	13.2	19.8	0.169681	0.232246007	0.19081213	-0.062565039	-0.021131161
312	pww190	17.4	23	0.3242917	0.341728416	0.340633394	-0.017436713	-0.01634169
313	pww191	14.4	16	0.1111779	0.124091084	0.135443129	-0.012913144	-0.024265188
314	pww192	12.7	15.3	0.0764978	0.106682812	0.108903056	-0.030184994	-0.032405238
315	pww193	17.4	23.4	0.3261798	0.356650583	0.352632856	-0.030470758	-0.026453032
316	pww194	18	25	0.4146637	0.419214836	0.416606925	-0.004551185	-0.001943274
317	pww195	14.3	19.2	0.1317144	0.213620374	0.194405994	-0.081906009	-0.062691629
318	pww196	13	19.4	0.1432289	0.219763542	0.180313869	-0.076534679	-0.037085006
319	pww197	15	22	0.2335315	0.30564602	0.268352262	-0.072114564	-0.034820806
320	pww198	13.2	17.1	0.1074991	0.153020209	0.141893852	-0.045521132	-0.034394774
321	pww199	14	19	0.1525035	0.207542339	0.186314235	-0.055038819	-0.033810715
322	pww200	11.2	15.2	0.0601776	0.104259479	0.094570318	-0.044081889	-0.034392728
323	pww201	12	16	0.0926096	0.124091084	0.112587915	-0.031481534	-0.019978365
324	pww202	17.3	31	0.5871554	0.699167614	0.615865141	-0.112012263	-0.02870979
325	pww203	16	25	0.3526777	0.419214836	0.370185018	-0.066537101	-0.017507283
326	pww204	16.3	26.2	0.3408978	0.469263671	0.414341103	-0.128365842	-0.073443274
327	pww205	12.2	16	0.0996609	0.124091084	0.114492524	-0.024430193	-0.014831632
328	pww206	17.3	28.3	0.4675058	0.563705295	0.513271365	-0.096199526	-0.045765596
329	pww207	16.1	30.2	0.5705434	0.657272713	0.543976806	-0.086729336	0.026566571
330	pww208	20.4	37.3	0.9496346	1.091005942	1.048282597	-0.141371385	-0.09864804
331	pww209	19.3	34.7	0.7899861	0.914689143	0.859833218	-0.124703019	-0.069847094
332	pww210	16.4	31	0.5342966	0.699167614	0.583852251	-0.164871023	-0.04955566
333	pww211	17	24.4	0.3947844	0.395206344	0.374684205	-0.000421955	0.020100184
334	pww212	20.3	43.4	1.3050456	1.606770187	1.405056509	-0.301724565	-0.100010887
335	pww213	19.4	37	0.9031103	1.069468711	0.981613103	-0.166358435	-0.078502827
336	pww214	19.2	35.9	0.4982508	0.993233958	0.915151952	-0.494983194	-0.416901187
337	pww215	20.5	43.1	1.1831056	1.57773683	1.399484883	-0.394631224	-0.216379276
338	pww216	23.4	54.1	2.1089538	2.919077517	2.461889728	-0.810123757	-0.352935967
339	ade01	11.5	16.8	0.1465895	0.144939696	0.119051678	0.001649845	0.027537862
340	ade02	20.72	37.8	1.1993965	1.127643691	1.092899954	0.07175285	0.106496587
341	ade03	17.4	46.5	1.5362506	1.93056488	1.383045257	-0.39431433	0.153205294
342	ade04	18.7	27.8	0.6191297	0.540396314	0.535389455	0.078733343	0.083740201
343	ade05	32.8	65.9	4.746394	5.026997112	4.869155124	-0.280603128	-0.12276114
344	ade06	33.2	73	6.27649	6.598312831	5.947258737	-0.321822852	0.329231242
345	ade07	30.6	58.9	4.3754509	3.693020852	3.71192477	0.682430096	0.663526178
346	adec01	12.7	23.7	0.2714218	0.368028477	0.263647501	-0.096606641	0.007774336
347	adec02	28.6	51.3	3.274926	2.521617944	2.691621383	0.753308069	0.58330463
348	adec03	19.9	25	0.4725858	0.419214836	0.460682251	0.053370955	0.01190354
349	adec04	19.9	29.4	0.8382868	0.616886513	0.63715299	0.221400335	0.201133858
350	adec05	20.65	23	0.502567	0.341728416	0.40449701	0.160838609	0.098070015
351	adec07	18.75	15.5	0.2077287	0.11157715	0.165881919	0.096151527	0.041846758

352	adec08	21.9	26	0.6011472	0.460730394	0.548443672	0.140416802	0.052703523
353	adec11	12.56	16.5	0.138982	0.137002286	0.125513197	0.001979731	0.01346882
354	adec15	22.1	38.5	1.3145823	1.180546489	1.207469318	0.134035858	0.107113029
355	adec16	21.04	37.5	1.166729	1.105548381	1.092241663	0.061180593	0.07448731
356	adec17	32.35	44.3	2.1778997	1.696271888	2.290872384	0.481627857	-0.112972638
357	adec18	48.65	32.9	1.5639632	0.80512685	1.915793134	0.758836303	-0.351829981
358	adec19	51.45	42.1	2.8753387	1.483804802	3.222584582	1.391533853	-0.347245926
359	adec20	24.8	38.2	1.3209021	1.157640586	1.331464616	0.163261515	-0.010562514
360	adec21	57.03	52.3	2.8427504	2.659033196	5.294195316	0.183717161	-2.451444959
361	adec22	24.85	38.6	1.4167554	1.188260147	1.361565082	0.2284953	0.055190365
362	adec23	18.7	31.9	0.9604225	0.748188101	0.704726396	0.212234371	0.255696076
363	adec24	18.7	31.9	0.9604225	0.748188101	0.704726396	0.212234371	0.255696076
364	adec25	28.9	40	1.758565	1.300434029	1.690115391	0.458131014	0.068449653
365	adec26	31.03	60.3	4.2661461	3.940727589	3.92739391	0.325418494	0.338752173
366	adec27	28.15	37.4	1.4609075	1.09825856	1.445873919	0.362648938	0.015033579
367	adec28	55.3	50	3.1370377	2.350432697	4.736997002	0.786604988	-1.599959317
368	adec29	29.72	51.3	2.8217445	2.521617944	2.790789783	0.300126549	0.03095471
369	adec30	49.1	54.3	3.2660649	2.948984715	4.942335479	0.317080227	-1.676270537
370	adec31	66.8	56	3.7689541	3.211413146	6.961877583	0.557540931	-3.192923506
371	adec32	52.65	31	0.9717002	0.699167614	1.843556918	0.272532544	-0.87185676
372	adw01	24.9	35.6	1.4781833	0.973160021	1.163908306	0.50502329	0.314275004
373	adw02	37.8	63.4	6.1204862	4.523658251	5.167278342	1.596827957	0.953207867
374	adw03	20.8	26.1	0.7349936	0.464987308	0.524902873	0.270006248	0.210090682
375	adw04	38.3	54.2	4.6226402	2.934005713	3.917210212	1.688634439	0.705429939
376	adw05	27.9	44.4	2.2329301	1.706440885	1.997492976	0.526489171	0.23543708
377	adw06	8.4	15.5	0.0939489	0.11157715	0.073383482	-0.017628215	0.020565454
378	adw08	39.5	82	9.9162869	8.833756938	8.710341762	1.082529922	1.205945098
379	adwc01	38.6	49	3.7233561	2.224424279	3.271630265	1.498931864	0.451725877
380	adwc02	42.3	55	5.1313661	3.055261562	4.411167143	2.076104576	0.720198995
381	adwc03	13.8	14.7	0.1351638	0.092381173	0.109241533	0.042782633	0.025922273
382	adwc04	46.6	67.5	7.3394899	5.36380378	7.050260196	1.975686107	0.289229691
383	adwc05	42.3	77.4	8.3946781	7.658762646	8.330542159	0.735915412	0.0641359
384	adwc06	36.5	39.5	2.6022024	1.259467501	2.065215552	1.342734885	0.536986834
385	psec01	34.86	59	4.8661657	3.710387895	4.200596966	1.155777805	0.665568733
386	psec02	20.44	35.2	1.0943671	0.94685378	0.936456004	0.147513286	0.157911063
387	psec05	15.62	20.2	0.2668422	0.244991273	0.23539173	0.021850957	0.0314505
388	psec06	20.08	40	1.2027392	1.300434029	1.184629812	-0.097694839	0.018109378
389	psec07	36.15	52.3	3.4820301	2.659033196	3.475079133	0.82299695	0.006951014
390	psec08	25.95	27.3	0.7745716	0.517609944	0.716207082	0.256961651	0.058364513
391	psec09	25.2	22.5	0.4727976	0.323470507	0.472554666	0.149327091	0.000242933
392	psec10	30.8	42.3	1.8776763	1.502243785	2.001294479	0.375432484	-0.123618209
393	psec11	14.18	16.5	0.1651028	0.137002286	0.141919631	0.028100477	0.023183132
394	psec12	28.3	39.4	1.5398474	1.251395649	1.608334538	0.288451741	-0.068487148
395	psec13	14.87	15	0.1309685	0.099460484	0.122771239	0.031508053	0.008197298
396	psec14	22.41	20.8	0.4166266	0.264605654	0.358871543	0.152020906	0.057755017

397	psec16	14.97	14.8	0.1073623	0.094725053	0.120289256	0.012637296	-0.012926907
398	psec18	19.8	21.3	0.3780388	0.281410139	0.332401018	0.096628704	0.045637825
399	psec19	22.8	29.6	0.6863147	0.626845133	0.739683377	0.059469616	-0.053368629
400	psec20	28.35	46.2	2.2200809	1.897296735	2.188476559	0.322784188	0.031604363
401	psec21	10.7	10	0.0182496	0.000143549	0.038114744	0.018106081	-0.019865114
402	psec22	23.8	29.5	0.8072566	0.621854469	0.766806743	0.185402137	0.040449863
403	psec24	28.16	49	2.5454807	2.224424279	2.432056831	0.321056412	0.11342386
404	psec25	30.85	65	4.2015133	4.842494615	4.486839151	-0.64098135	-0.285325887
405	psec26	39.7	75.3	9.531324	7.144898946	7.448520951	2.386425085	2.08280308
406	psec27	32.8	44.5	2.3214515	1.716655086	2.341134854	0.604796458	-0.01968331
407	psec28	33.3	39.8	2.0320638	1.283925535	1.91891426	0.748138268	0.113149543
408	psec29	28.75	40	1.9996461	1.300434029	1.681627943	0.699212049	0.318018135
409	psec30	34.7	55.3	3.8637704	3.101572208	3.710559919	0.762198161	0.15321045
410	psec31	35.7	45.8	3.0849666	1.853592945	2.678785463	1.231373635	0.406181117
411	psec32	38.15	54.8	4.2764221	3.02464236	3.983305546	1.251779696	0.29311651
412	psw01	31.9	42.5	2.2477601	1.520855699	2.088463408	0.726904367	0.159296658
413	psw02	32.8	69.3	5.812673	5.755477923	5.341983945	0.057195122	0.470689099
414	psw03	46.5	87.3	13.658889	10.27163625	11.47706341	3.387252578	2.181825421
415	psw04	34.3	59	4.1914507	3.710387895	4.138273437	0.481062774	0.053177232
416	psw05	19.8	23	0.4836929	0.341728416	0.387798613	0.14196451	0.095894314
417	psw06	12.9	15.5	0.1428185	0.11157715	0.113600669	0.031241301	0.029217783
418	psw08	23.4	38	1.3938314	1.142564772	1.2448393	0.251266659	0.148992131
419	pswc01	48.8	81	11.528299	8.572554508	10.41099467	2.955744271	1.11730411
420	pswc02	10.4	17	0.1333882	0.150310789	0.110117876	-0.016922574	0.023270339
421	pswc03	27.3	38	1.8392034	1.142564772	1.447524607	0.696638588	0.391678753
422	pswc04	43.4	63.5	6.5081007	4.543234697	5.887330922	1.964866004	0.620769779
423	pswc05	25.5	46.5	2.1426222	1.93056488	2.002242864	0.212057352	0.140379367
424	pswc07	45.7	57.5	5.6045165	3.455189153	5.140839739	2.149327356	0.463676769
425	pswc08	14.2	27	0.5280433	0.504184138	0.383252545	0.023859195	0.144790788
426	psw09	22	32.5	1.0359494	0.782029751	0.859780393	0.253919698	0.176169057
427	psw10	40	85.5	7.970598	9.773204327	9.545792628	-1.802606324	-1.575194625
428	psw11	32	48.9	2.8292947	2.212092292	2.733809767	0.617202397	0.095484922
429	psw12	44	74	6.6161008	6.833875758	7.942133286	-0.217775004	-1.326032531
430	psw13	35	65.2	5.4473411	4.883179498	5.068431619	0.564161589	0.378909468
431	psw14	35	36.9	1.6504966	1.062362323	1.740129517	0.588134311	-0.089632882
432	psw15	19.3	45	1.4779281	1.768407236	1.435395156	-0.290479154	0.042532927
433	psw16	24.4	70.6	4.1510989	6.046173945	4.209244035	-1.89507504	-0.05814513
434	psw17	20.7	47	1.9397207	1.986951971	1.671944248	-0.04723124	0.267776483
435	psw18	19.4	36.2	0.8231394	1.013609715	0.939996103	-0.190470342	-0.11685673
436	psw19	36.3	69.6	4.6089895	5.822000846	5.913611612	-1.213011356	-1.304622123
437	psw20	28.7	57.9	2.6629234	3.522128093	3.387794391	-0.859204681	-0.724870978
438	psw21	30	67	5.7029205	5.257368776	4.623923726	0.445551683	1.078996733
439	psw22	38	55	4.0209034	3.055261562	3.995646313	0.96564181	0.02525706
440	psw23	30.5	69	4.4692056	5.689301592	4.956153273	-1.220095977	-0.486947658
441	psw24	31	54.5	2.6906521	2.979095202	3.251838232	-0.288443113	-0.561186143

442	psw25	33	65	3.9188213	4.842494615	4.774053978	-0.923673305	-0.855232669
443	psw26	42	67	4.7742189	5.257368776	6.309183931	-0.483149862	-1.534965017
444	psw27	43.7	65	5.0567097	4.842494615	6.187490161	0.214215118	-1.130780428
445	psw28	44	75	6.2345992	7.072643624	8.146415543	-0.838044423	-1.911816342
446	psw29	39	74	7.8713022	6.833875758	7.088983773	1.037426429	0.782318414
447	psw30	49	74	6.6186941	6.833875758	8.795282798	-0.215181689	-2.176588729
448	psw31	56	66	7.3349463	5.047721069	8.035362772	2.287225278	-0.700416425
449	psw32	41.5	86	9.7555936	9.910616035	9.998354481	-0.155022401	-0.242760847
450	psw33	41.4	76	7.0084848	7.314616427	7.885497619	-0.306131604	-0.877012796
451	psw34	40	66	5.4722662	5.047721069	5.863657707	0.424545085	-0.391391553
452	psw35	43	73	4.7478882	6.598312831	7.574543629	-1.850424582	-2.82665538
453	psw36	10.2	17.5	0.139818	0.164017337	0.114512984	-0.02419933	0.025305023
454	psw37	24	82.3	6.1170375	8.91274263	5.499360443	-2.795705127	0.61767706
455	psw38	27	99.5	9.2739382	13.92359876	8.763585707	-4.649660606	0.510352448
456	psw39	26.3	74	5.2099301	6.833875758	4.918691192	-1.623945644	0.291238922
457	psw40	25.3	68.7	4.2399199	5.623477295	4.138588846	-1.383557422	0.101331027
458	psw41	23.4	86	6.1580162	9.910616035	5.827082011	-3.752599826	0.330934198
459	psw42	24.7	74.2	5.0153942	6.881372936	4.665623904	-1.865978707	0.349770326
460	psw43	22.1	62.8	3.0515762	4.407197997	3.089237592	-1.355621809	-0.037661405
461	lge01	19.39	34.5	0.9570428	0.902041328	0.853951361	0.055001509	0.103091476
462	lge02	20.45	44.5	1.7758216	1.716655086	1.48596855	0.059166506	0.289853043
463	lge03	14.26	26.9	0.4418653	0.499749339	0.38202234	-0.057883996	0.059843003
464	lge05	29.31	56.3	3.3686232	3.259252001	3.279038405	0.109371219	0.089584816
465	lge06	31.3	58.3	3.4031252	3.589878275	3.719296323	-0.186753114	-0.316171162
466	lge07	30.2	63.5	4.2182982	4.543234697	4.21421199	-0.324936491	0.004086216
467	lge08	8.9	13.7	0.0538892	0.069816365	0.06045078	-0.015927174	-0.006561589
468	lgec01	19.6	46	1.3680938	1.875351715	1.5208617	-0.507257934	-0.152767919
469	lgec02	21.5	53	2.0330227	2.758214872	2.18440949	-0.725192174	-0.151386792
470	lgec03	15.1	24.6	0.3632237	0.403135315	0.338155476	-0.039911661	0.025068177
471	lgec04	20.88	37	1.0989692	1.069468711	1.05567092	0.029500517	0.043298308
472	lgec05	12.9	13	0.0687297	0.054966497	0.079409783	0.013763197	-0.010680089
473	lgec06	17.02	57.1	1.73383	3.389062828	2.014590295	-1.655232857	-0.280760324
474	lgec07	15	41.9	1.0196516	1.465537961	0.973395992	-0.445886322	0.046255647
475	lgwc01	12	18.8	0.1875185	0.201529269	0.156083816	-0.014010745	0.031434708
476	lgwc02	21	45	1.5079739	1.768407236	1.558323199	-0.260433383	-0.050349346
477	lgwc03	29.3	29.8	1.2959334	0.63689506	0.96187505	0.659038321	0.334058332
478	lgwc04	34.2	65	4.779314	4.842494615	4.933663711	-0.063180606	-0.154349702
479	lgwc05	35.9	58	4.0891999	3.538989645	4.182062761	0.550210218	-0.092862898
480	lgwc06	31	39.8	1.7402992	1.283925535	1.791162432	0.456373657	-0.05086324
481	lgwc07	46.98	73	7.7715356	6.598312831	8.235420413	1.173222808	-0.463884774
482	lgwc08	8	10	0.0724224	0.000143549	0.028070909	0.072278824	0.044351464
483	lgw01	25.7	49.1	2.7357649	2.23680497	2.238320164	0.498959886	0.497444692
484	lgw02	27.3	54.1	3.0410412	2.919077517	2.84739642	0.121963646	0.193644743
485	lgw03	22.3	25.5	0.6463477	0.439734947	0.537185588	0.206612767	0.109162125
486	lgw05	36.7	83.2	9.6743299	9.151430372	8.350392685	0.522899492	1.323937178

487	lgw06	12.9	19.8	0.2001937	0.232246007	0.186437573	-0.032052299	0.013756134
488	lgw07	23.5	37.6	1.2227227	1.112875666	1.224341151	0.109847075	-0.00161841
489	lgw08	33.93	69.9	5.8419841	5.888864759	5.599959632	-0.046880668	0.242024459
490	tde01	36.6	67.3	5.2614186	5.321102967	5.59963812	-0.0596844	-0.338219553
491	tde02	31.02	38	1.4604349	1.142564772	1.638883265	0.317870088	-0.178448404
492	tde03	35.3	81	6.2153423	8.572554508	7.651080925	-2.357212183	-1.435738599
493	tde04	36.55	45.5	2.5233348	1.821302584	2.705148268	0.702032248	-0.181813436
494	tde05	29.52	54	3.0866798	2.90420011	3.053445071	0.182479734	0.033234774
495	tde06	14.1	26	0.3682296	0.460730394	0.352783554	-0.092500815	0.015446025
496	tde07	11.3	15.7	0.1257627	0.116535052	0.101924228	0.009227612	0.023838436
497	tdec01	29.55	56.5	3.1405406	3.291399251	3.325983665	-0.150858627	-0.185443042
498	tdec02	23	34	0.9729638	0.870952741	0.982689248	0.10201106	-0.009725447
499	tdec03	35	71	6.9644983	6.136854883	5.932058674	0.827643402	1.03243961
500	tdec04	27.3	48	2.5148261	2.103285657	2.270696765	0.41154046	0.244129352
501	tdec05	28.55	47.3	2.5549247	2.02135169	2.304192478	0.533573009	0.250732222
502	tdec06	27	45	2.1349449	1.768407236	1.986140667	0.366537631	0.148804201
503	tdec07	24.6	24	0.5555284	0.379567576	0.524918886	0.175960808	0.030609498
504	tdec08	25.2	22	0.5231682	0.30564602	0.451750601	0.217522181	0.0714176
505	tdec09	32.7	75.4	5.8707149	7.169048152	6.227132385	-1.298333247	-0.35641748
506	tdec10	36	86.5	9.0755426	10.04882898	8.827595291	-0.973286419	0.247947267
507	tdec11	33.7	63	3.6867364	4.445827262	4.594990807	-0.759090871	-0.908254416
508	tdec12	26.3	28.7	0.8022804	0.58273701	0.801850046	0.21954341	0.000430374
509	tdec13	34.3	52.2	3.2082106	2.645065891	3.297413591	0.563144729	-0.089202971
510	tdec14	32.3	58.3	4.3316249	3.589878275	3.829251906	0.741746608	0.502372977
511	tdec15	31.3	57.5	3.8114231	3.455189153	3.625176694	0.356233934	0.186246393
512	tdec16	25.3	42	1.6125506	1.474649914	1.633080104	0.137900713	-0.020529477
513	tdec17	29.4	46.9	1.9570687	1.975580176	2.331416083	-0.018511473	-0.374347379
514	tdec18	21.6	35.8	1.0672618	0.986509414	1.022753974	0.080752353	0.044507794
515	tdec19	19.45	22.7	0.4447184	0.330721355	0.371016764	0.113997049	0.073701641
516	tdec20	29.7	37.5	1.5807491	1.105548381	1.531273847	0.475200745	0.049475279
517	tdec21	35.6	74.8	6.7306523	7.024633656	6.640890954	-0.293981347	0.089761355
518	tdec22	36.1	75	7.1978091	7.072643624	6.761761363	0.125165492	0.436047753
519	tdec23	35.8	61.3	4.6332583	4.123639688	4.619347958	0.50961862	0.01391035
520	tdec28	15.2	20	0.2899439	0.238585688	0.224473738	0.05135821	0.06547016
521	tdec29	14.6	18.3	0.2062366	0.186779762	0.180191644	0.019456873	0.026044991
522	tdec30	13.6	16.3	0.1685377	0.131790133	0.132727006	0.036747573	0.035810701
523	tdec31	13.9	14.7	0.1077512	0.092381173	0.110045375	0.015370018	-0.002294184
524	tdec32	40.6	64.9	5.2146709	4.822220469	5.76290967	0.392450392	-0.54823881
525	tdw01	23.2	33.5	1.1358508	0.840603262	0.962484148	0.295247565	0.173366679
526	tdw02	22.9	27.5	0.5937367	0.526662534	0.641493241	0.067074131	-0.047756575
527	tdw03	31.6	47	2.9114173	1.986951971	2.506708029	0.924465285	0.404709227
528	tdw04	8.6	19.5	0.1503929	0.222859607	0.11995897	-0.072466658	0.030433979
529	tdw05	35.3	95	10.923608	12.52103786	10.36131694	-1.597429975	0.56229095
530	tdw07	30.6	56.5	3.7135011	3.291399251	3.435902951	0.422101819	0.27759812
531	tdw08	30.6	69	5.2186121	5.689301592	4.971113479	-0.470689517	0.247498596

532	tdwc01	30.5	37	1.7983308	1.069468711	1.530877288	0.728862135	0.267453558
533	tdwc02	17.9	18	0.2465611	0.178123495	0.214045544	0.068437645	0.032515596
534	tdwc03	44.5	89.5	11.816857	10.89493255	11.54144348	0.921924907	0.27541398
535	tdwc04	46.4	69.5	8.4207462	5.79978837	7.418016556	2.620957863	1.002729677
536	tdwc05	34.8	47.4	3.4297882	2.032913287	2.789897425	1.39687494	0.639890802
537	tdwc06	42.7	58	5.8350858	3.538989645	4.906866477	2.296096202	0.928219371
538	tdwc07	29.8	29.5	1.1024038	0.621854469	0.958720106	0.480549323	0.143683686
539	tdw09	25.14	105	6.7508278	15.72597565	9.070873772	-8.975147893	-2.320046014
540	tdw10	7.5	21.5	0.1414937	0.288249789	0.127276998	-0.146756068	0.014216722
541	tdw11	8	12.7	0.0493324	0.048840628	0.046310512	0.000491801	0.003021917
542	tdw12	20	51.5	2.0021217	2.548700337	1.929274354	-0.546578681	0.072847301
543	tdw13	23	62	3.3435928	4.254606106	3.130760137	-0.911013331	0.212832638
544	tdw14	21	56	2.3460311	3.211413146	2.372071056	-0.865382063	-0.026039973
545	tdw15	23	46	2.0003088	1.875351715	1.775775725	0.124957123	0.224533114
546	tdw16	22	50	2.4139078	2.350432697	1.997460106	0.063475066	0.416447656
547	tdw17	32	70	4.0974604	5.911227514	5.319417721	-1.813767157	-1.221957364
548	tdw18	28	52	3.2950799	2.617282066	2.706643123	0.677797843	0.588436787
549	tdw19	39	110	14.534715	17.44862971	15.13862703	-2.913914717	-0.603912037
550	tdw20	11.5	27.7	0.3545569	0.535797611	0.326483737	-0.181240725	0.02807315
551	tdw21	20.7	117	10.089381	19.99495278	9.263870026	-9.9055722	0.825510558
552	tdw22	25	136	15.181787	27.69802076	14.84261095	-12.51623344	0.339176372
553	tdw23	24	110	10.2817	17.44862971	9.483161857	-7.166929515	0.79853834
554	tdw24	17.3	72.2	2.9753487	6.412170044	3.189297867	-3.436821356	-0.213949178
555	tdw25	19.1	87.6	5.3179512	10.35571779	4.998825422	-5.037766606	0.319125767
556	tdw26	16.4	61.5	2.1116859	4.160813987	2.240766617	-2.049128039	-0.129080668
557	ccw01	42.2	52.4	3.4879384	2.673050812	4.025227056	0.814887604	-0.53728864
558	ccw02	45.7	70	7.4000172	5.911227514	7.41198406	1.488789662	-0.011966884
559	ccw03	32.94	37.5	1.6349765	1.105548381	1.693010012	0.529428155	-0.058033477
560	ccw04	35.3	49	2.3632354	2.224424279	3.009402339	0.138811149	-0.646166911
561	ccw05	22.1	25.3	0.5475074	0.431470347	0.524043706	0.11603703	0.023463671
562	ccw06	32.95	28.7	0.962797	0.58273701	1.002907639	0.380059985	-0.040110644
563	ccw07	25.79	22.5	0.5903419	0.323470507	0.48363443	0.266871345	0.106707423
564	ccw08	23.8	19.2	0.3866292	0.213620374	0.324618	0.173008802	0.062011176
565	ccw09	44.11	42.4	2.6609522	1.511528077	2.827201006	1.149424158	-0.166248772
566	ccw10	30.5	30	1.0202798	0.647037259	1.01422182	0.373242524	0.006057963
567	ccw11	43.79	56	4.7444037	3.211413146	4.707819646	1.532990537	0.036584036
568	ccw12	57.5	72.3	9.7181441	6.43532572	9.800029158	3.282818392	-0.081885046
569	ccw14	16.28	17.3	0.1927586	0.158486859	0.179561071	0.034271726	0.013197514
570	ccw15	12.75	15.2	0.1024809	0.104259479	0.107891865	-0.001778597	-0.005410983
571	ccw16	51	59	6.748561	3.710387895	5.966210262	3.038173144	0.782350777
572	ccw17	49	64	6.5127826	4.641824046	6.688271475	1.870958588	-0.175488841
573	ccw18	55	62.5	7.4163415	4.349613974	7.128860256	3.066727521	0.28748124
574	ccw19	65	88	14.575511	10.46827521	16.11890766	4.107235799	-1.543396653
575	ccw20	46	44	2.9600213	1.666035223	3.152072555	1.293986078	-0.192051254
576	ccw21	21	16.5	0.2402757	0.137002286	0.210982823	0.103273404	0.029292867

577	ccw22	42.29	46.5	3.2115109	1.93056488	3.230865531	1.280946004	-0.019354648
578	ccw23	65	74.5	12.166228	6.952859074	11.6757452	5.213368609	0.490482485
579	ccw24	56	61.5	7.1908349	4.160813987	7.034205218	3.030020907	0.156629676
580	ccw25	38.8	35	1.5515004	0.933893445	1.735672983	0.617606938	-0.1841726
581	ccw26	36	34	1.685648	0.870952741	1.525939669	0.814695215	0.159708287
582	ccw27	33	36	1.7689354	0.999992036	1.566971039	0.768943374	0.201964372
583	ccw29	16	17.6	0.198472	0.166806544	0.182675047	0.031665474	0.015796972
				1377.76234	**1412.291311**	**1376.200125**	**-34.5289679**	**1.56221813**

From the above table, the difference [A-B] provides difference between the volume measured in the field (actual volume) and the volume predicted by model 7. The figures with negative (-) indicates that the volume has been over-predicted by the model 7 vis-à-vis actual volume of the particular tree. And the figures without negative (-) sign indicates the under prediction of volume by the model 7.

Similarly, the difference [A-C] is the difference between the actual volume and the volume predicted by the model 16. Same explanation is applicable here – the figures with negative sign indicates overprediction of volume by the model and vice-versa, while those figures without (-) are under prediction of volume by the model 16.

Summation of the figures in the difference column result in -34.5289679 and 1.56221813 for model 7 and model 16 respectively. These indicate that the model 7 over predicts total volume for 583 trees by 34.5289679 m^3, while the model 16 under predicts by 1.56221813 m^3 of volume.

12. Limitations of the model

The model has the following limitations;

1. The modeling has been done based on only 583 sample trees. The model can further be improved by increasing the samples.

2. The diameter for the samples ranges between minimum of 10 cm to 136 cm (over bark). However, the model prediction for trees of bigger diameter classes should be done with caution, since there were lesser number of samples trees.

13. Conclusion

The model 16 which uses the height performs much better than the model 7 that is fitted without height as predictor, as empirically shown above.

Also, the model 16 has the lowest AIC and BIC values. Therefore, this leads us to conclude that the best model for *Conifer*, out of 16 models fitted above, is model 16.

But since the two models are fitted with different predictors (one with and other without height as predictor), it leads us to conclude two best fit models for *Conifer*, namely;

1. Model 7: the best fit model that doesn’t use height
2. Model 16: the best fit model which uses height as predictor.

14. Acknowledgement

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16. Annexure – Dataset for Conifers

SN	Tree_ID	Height.m	DBH.cm	Volume.m3	BA.m2	BAH.m3	DBH2H.m3
1	prwc01	22.6	37	1.441940909	0.107521009	2.429974794	3.09394
2	prwc02	24.5	46	2.442090437	0.166190251	4.071661159	5.1842
3	prwc03	21.6	26.6	0.715731942	0.055571632	1.200347261	1.5283296
4	prwc04	26.7	55.4	3.461517553	0.241051263	6.436068715	8.1946572
5	prwc05	13.5	19	0.208554208	0.028352874	0.382763795	0.48735
6	prwc07	25.6	75.5	5.378670693	0.447696588	11.46103266	14.59264
7	prwc08	30.5	68.5	5.766942958	0.368528453	11.24011782	14.3113625
8	pre01	37.47	77.8	7.74458705	0.475388942	17.81282365	22.6799915
9	pre02	36.9	57.4	4.171510005	0.258769845	9.548607291	12.1576644
10	pre04	39.4	62	5.329933918	0.301907054	11.89513793	15.14536
11	pre05	23.94	32.5	1.036424392	0.082957681	1.986006883	2.5286625
12	pre06	37.1	68.5	5.521934163	0.368528453	13.67240561	17.4082475
13	pre07	27.9	47.8	2.448771101	0.179450914	5.0066805	6.3747036
14	pre08	36.8	59.8	4.887448583	0.280861525	10.33570411	13.1598272
15	pre09	29.4	39.7	2.018457064	0.123785819	3.639303083	4.6337046
16	pre10	40.41	67.4	6.174833233	0.356787536	14.41778433	18.3572932
17	pre11	37.63	76.2	7.052333044	0.456036731	17.16066219	21.8496337
18	pre13	13.16	19.2	0.192868574	0.028952918	0.3810204	0.48513024
19	pre15	21.18	27.8	0.632966764	0.060698712	1.285598713	1.63687512
20	pre16	23.1	52.2	2.697802689	0.214008433	4.943594806	6.2943804
21	pre17	25.8	40.9	1.533572031	0.13138219	3.389660506	4.3158498
22	pre18	19.9	23	0.380403935	0.041547563	0.826796501	1.05271
23	pre20	34.79	73	6.411429646	0.418538681	14.56096072	18.539591
24	pre21	31.12	50	2.935316039	0.196349541	6.110397711	7.78
25	pre22	27.8	36.2	1.463890676	0.102921717	2.86122373	3.6430232
26	pre23	41.9	65.3	5.767943771	0.334900845	14.03234542	17.8665371
27	pre24	28.65	54.6	2.862305446	0.234139759	6.708104092	8.5410234
28	pre28	13.99	16.8	0.172147753	0.022167078	0.310117418	0.39485376
29	pre29	19.8	27.4	0.655721333	0.058964553	1.16749814	1.4865048
30	pre31	28.83	34.4	1.503784033	0.092940877	2.679485486	3.41162688
31	pre33	24.9	46	1.660082464	0.166190251	4.138137259	5.26884
32	pre34	10.85	14.1	0.082489012	0.015614501	0.169417335	0.21570885
33	pre35	17.86	29.1	0.600397899	0.066508302	1.187838271	1.51240266
34	prec01	25.1	31.5	0.907353319	0.077931133	1.956071432	2.4905475
35	prec02	34.7	64.4	5.129291189	0.325732893	11.30293138	14.3913392
36	prec03	26.1	28.5	0.822367727	0.063793966	1.665022508	2.1199725
37	prec04	17.65	15	0.128726341	0.017671459	0.311901246	0.397125
38	prec05	33.65	44.3	2.369717651	0.154133604	5.18659578	6.60377885
39	prec07	37.32	75.3	8.271028784	0.445327827	16.61963451	21.1607759
40	prec08	37.8	54	3.40957869	0.229022104	8.657035548	11.02248
41	jre01	17.05	24	0.417693623	0.045238934	0.771323828	0.98208

42	jre02	14.95	37.3	0.708499778	0.109271661	1.633611333	2.07997855
43	jre03	21.4	54	2.050983698	0.229022104	4.901073035	6.24024
44	jre04	24.1	47.5	1.786968863	0.177205461	4.270651601	5.4375625
45	jre05	26.9	63	2.765152766	0.311724531	8.385389885	10.67661
46	jre06	28.9	71.6	4.146103863	0.402639081	11.63626944	14.8157584
47	jre08	10.3	13	0.070050339	0.013273229	0.136714258	0.17407
48	jrec01	16.5	26.8	0.473646096	0.056410438	0.930772222	1.185096
49	jrec02	20.3	44.4	1.51479722	0.154830252	3.143054122	4.0018608
50	jrec03	21.7	39	1.129432213	0.119459061	2.592261616	3.30057
51	jrec04	18.75	32	0.618633744	0.080424772	1.507964474	1.92
52	jrec06	23	42	1.537156974	0.138544236	3.186517429	4.0572
53	jrec07	21.35	36	1.093081022	0.101787602	2.173165302	2.76696
54	jrec08	13.95	15.2	0.118677239	0.018145839	0.253134456	0.3223008
55	jrec09	22.5	47	1.590720282	0.173494454	3.903625222	4.97025
56	jrec10	22.6	61.5	2.419587798	0.29705722	6.71349318	8.547885
57	jrec11	10.95	18	0.117363299	0.0254469	0.27864356	0.35478
58	jrec12	21.1	57.7	2.263579361	0.261481825	5.51726651	7.0248019
59	jrec13	21.4	50.5	1.974207923	0.200296167	4.286337966	5.457535
60	jrec14	22.42	27.3	0.670486573	0.05853494	1.312353349	1.67094018
61	jrec17	7.38	12.4	0.041818245	0.012076282	0.089122962	0.11347488
62	jrec19	19.4	54	1.786607484	0.229022104	4.443028826	5.65704
63	jrec20	8	14.3	0.071023339	0.016060607	0.128484856	0.163592
64	jrec21	9.6	18.4	0.118562161	0.02659044	0.255268226	0.3250176
65	jrec22	8.95	10.3	0.033320581	0.008332289	0.074573988	0.09495055
66	jrec23	11.15	20.6	0.181071786	0.033329156	0.371620095	0.4731614
67	jrec24	20.45	41.2	1.230721499	0.133316626	2.726324999	3.4712648
68	jrec25	20.94	38	1.126660221	0.113411495	2.374836701	3.023736
69	jrec26	19.31	30	0.653205241	0.070685835	1.364943468	1.7379
70	jrec27	15	45.3	1.023007594	0.161170772	2.417561576	3.078135
71	jrec28	21.66	68.8	2.024214973	0.371763508	8.052397589	10.252631
72	jrec29	15.78	20.8	0.301696092	0.033979466	0.536195976	0.68270592
73	jrec30	16.2	29.4	0.61192477	0.067886676	1.099764146	1.4002632
74	jrec31	19.11	58	2.377623807	0.264207942	5.049013775	6.428604
75	jrec32	22.58	66.3	2.778846934	0.345236685	7.795444354	9.92546802
76	jrwc01	32.4	85	8.197200354	0.567450173	18.38538561	23.409
77	jrwc02	25.6	53.5	2.447379968	0.224800589	5.754895087	7.32736
78	jrwc03	24.4	38	1.432295093	0.113411495	2.767240473	3.52336
79	jrwc04	28.6	66	5.087699119	0.34211944	9.784615983	12.45816
80	jrwc05	24.6	46	2.073262676	0.166190251	4.088280184	5.20536
81	jrwc06	19.9	29	0.590300189	0.066051986	1.314434512	1.67359
82	jrwc08	9.6	18.6	0.147960361	0.027171635	0.260847695	0.3321216
83	jrw01	28.3	78.8	5.99243998	0.487688277	13.80157824	17.5727152
84	jrw02	16.83	27.6	0.562648318	0.05982849	1.006913495	1.28204208
85	jrw03	11.15	18.5	0.17963732	0.026880252	0.299714811	0.38160875
86	jrw04	16	33.5	0.674547272	0.088141309	1.410260942	1.7956

87	jrw05	17.6	44.6	1.155740271	0.156228261	2.749617395	3.5009216
88	jrw06	24.28	64.5	3.957572555	0.326745271	7.933375178	10.101087
89	jrw08	18.05	56.6	2.572025692	0.251607014	4.541506603	5.7824258
90	pwec01	10.9	14.5	0.07811272	0.016512996	0.179991661	0.2291725
91	pwec02	33.33	37	1.86944615	0.107521009	3.583675216	4.562877
92	pwec03	25.2	27	0.822745708	0.057255526	1.442839258	1.83708
93	pwec04	35.2	69.8	4.565907308	0.382649127	13.46924926	17.1495808
94	pwec05	26.5	28.5	0.901823838	0.063793966	1.690540094	2.1524625
95	pwec07	13.2	12	0.04959452	0.011309734	0.149288483	0.19008
96	pwec09	8.5	10	0.021252812	0.007853982	0.066758844	0.085
97	pwec10	34.65	71.7	6.719217904	0.403764556	13.99044188	17.8131839
98	pwec11	37.2	65.8	5.640110885	0.34004913	12.64982765	16.1062608
99	pwec12	33.3	57.2	4.599074818	0.256969713	8.557091433	10.8952272
100	pwec13	27.82	40	1.466955183	0.125663706	3.495964305	4.4512
101	pwec14	31.7	73.5	6.325423533	0.424291723	13.45004761	17.1251325
102	pwec15	16.25	15.3	0.146148587	0.018385386	0.298762516	0.38039625
103	pwec16	26.56	60.6	3.907715846	0.28842648	7.660607307	9.75378816
104	pwec18	31.53	62.7	4.277387697	0.308762795	9.735290913	12.3953574
105	pwec19	51.5	95.8	16.71400864	0.72081016	37.12172324	47.264846
106	pwec20	28.1	30.3	0.899288218	0.07210662	2.026196022	2.5798329
107	pwec21	32.55	55.7	4.372989047	0.243668995	7.931425781	10.098605
108	pwec22	17.92	21.9	0.321092933	0.037668481	0.675019185	0.85946112
109	pwec23	11.28	17	0.118463899	0.022698007	0.256033518	0.325992
110	pwec24	18.82	31.3	0.740416435	0.076944673	1.44809874	1.84377658
111	pwec25	46.81	71.2	8.161811153	0.398152887	18.63753662	23.7300486
112	pwec29	23.69	35.6	1.157501856	0.099538222	2.358060471	3.00237584
113	pwec30	26.51	24.1	0.634743019	0.045616711	1.209299001	1.53972731
114	pwec31	25.85	42.5	2.270154193	0.141862543	3.667146743	4.66915625
115	pwec32	15.27	13.3	0.076559951	0.013892908	0.212144707	0.27011103
116	pwec35	30.3	47.6	2.941105607	0.177952374	5.39195694	6.8652528
117	pwec36	34.54	66.7	5.77971536	0.349415004	12.06879422	15.3664661
118	pwwc01	61.3	78.5	15.19105879	0.483981983	29.66809557	37.7745925
119	pwwc02	50.5	65.5	7.884369584	0.336955447	17.01625008	21.6657625
120	pwwc03	47.4	49	3.997815305	0.188574099	8.938412294	11.38074
121	pwwc04	25.6	35.8	1.294802757	0.10065977	2.576890117	3.2809984
122	pwwc05	43.4	57.5	5.890892001	0.259672268	11.26977642	14.349125
123	pwwc06	20.5	28	0.626011281	0.061575216	1.262291928	1.6072
124	pwwc07	15.5	19.4	0.188014554	0.029559245	0.458168302	0.583358
125	pww01	40.4	68.2	7.114065193	0.365307535	14.75842443	18.7910096
126	pww02	32.3	46.7	2.516508663	0.1712867	5.532560412	7.0442747
127	pww03	34.3	59.8	4.324317906	0.280861525	9.633550301	12.2658172
128	pww04	29.7	29.5	1.001794392	0.068349275	2.029973473	2.5846425
129	pww05	20.6	16.9	0.220556269	0.022431757	0.462094193	0.5883566
130	pww06	25.6	35.2	1.158843313	0.097313974	2.491237735	3.1719424
131	pww07	46.7	79.5	10.20936659	0.496391274	23.18147251	29.5155675

132	pww09	30	54	3.680907783	0.229022104	6.870663133	8.748
133	pww10	35	79	9.103551287	0.490166994	17.15584478	21.8435
134	pww11	24	37.2	1.09442659	0.108686539	2.608476947	3.321216
135	pww12	29	49.5	2.578731735	0.192442185	5.580823365	7.105725
136	pww13	31	45.6	5.977509372	0.163312553	5.062689128	6.446016
137	pww14	37	75.5	6.455855362	0.447696588	16.56477376	21.090925
138	pww15	32.2	59.8	3.7148191	0.280861525	9.043741099	11.5148488
139	pww16	31.3	51.4	2.861488217	0.207499053	6.494720364	8.2693348
140	pww17	32.4	58.9	3.545911709	0.272471116	8.828064166	11.2402404
141	pww18	31.6	51.8	2.866773332	0.210741177	6.659421187	8.4790384
142	pww19	29.7	44.7	2.532482126	0.156929622	4.660809762	5.9343273
143	pww20	31.2	46.4	2.331334252	0.169093083	5.275704189	6.7172352
144	pww21	24.6	53.3	2.544645206	0.223122979	5.488825279	6.9885894
145	pww22	24.3	56.8	2.484115701	0.253388297	6.157335619	7.8397632
146	pww23	23.4	63.8	2.826222155	0.31969161	7.480783675	9.5248296
147	pww24	25	42.3	0.980704033	0.140530508	3.513262699	4.473225
148	pww25	25	38.7	0.970184248	0.117628298	2.940707438	3.744225
149	pww26	21	47	1.033627869	0.173494454	3.64338354	4.6389
150	pww27	23	57	2.046356251	0.255175863	5.869044856	7.4727
151	pww28	23	56.8	2.759747829	0.253388297	5.827930833	7.420352
152	pww29	23	43.8	1.747232967	0.150673925	3.465500281	4.412412
153	pww30	26	48.4	2.333365965	0.183984232	4.783590036	6.090656
154	pww31	25	57.2	2.908168462	0.256969713	6.424242817	8.1796
155	pww32	26	57.2	2.868785114	0.256969713	6.68121253	8.506784
156	pww33	26	58.5	2.847817332	0.268782886	6.988355048	8.89785
157	pww34	22	70	2.918280283	0.3848451	8.466592201	10.78
158	pww35	21	39	0.850265096	0.119459061	2.508640274	3.1941
159	pww36	14	40.2	0.880749198	0.126923485	1.776928787	2.262456
160	pww37	23	50	1.54008106	0.196349541	4.51603944	5.75
161	pww38	25	56	2.244867091	0.246300864	6.157521601	7.84
162	pww39	14	30	0.452232024	0.070685835	0.989601686	1.26
163	pww40	13.5	24.6	0.310035789	0.047529155	0.641643596	0.816966
164	pww41	12	27	0.338291982	0.057255526	0.687066313	0.8748
165	pww42	42	53	2.943593393	0.220618344	9.265970452	11.7978
166	pww43	47	49	3.155670774	0.188574099	8.862982654	11.2847
167	pww44	47	52	2.700541669	0.212371663	9.981468179	12.7088
168	pww45	7	20	0.09445905	0.031415927	0.219911486	0.28
169	pww46	9.5	18.7	0.10930183	0.027464588	0.26091359	0.3322055
170	pww47	13	28	0.382066958	0.061575216	0.800477808	1.0192
171	pww48	7	20.9	0.066456059	0.034306977	0.24014884	0.305767
172	pww49	8.7	16	0.074873143	0.020106193	0.174923879	0.22272
173	pww50	6.6	17	0.062233623	0.022698007	0.149806846	0.19074
174	pww51	8	17.6	0.07155903	0.024328494	0.194627948	0.247808
175	pww52	8.2	15	0.063951124	0.017671459	0.144905961	0.1845
176	pww53	11	22.3	0.19257149	0.039057065	0.429627718	0.547019

177	pww54	13	21.7	0.193346285	0.036983614	0.480786984	0.612157
178	pww55	8	17	0.097020191	0.022698007	0.181584055	0.2312
179	pww56	6.4	19.6	0.095293191	0.030171856	0.193099877	0.2458624
180	pww57	11	24.8	0.211824714	0.048305129	0.531356415	0.676544
181	pww58	9	17	0.106699555	0.022698007	0.204282062	0.2601
182	pww59	11	22	0.200190072	0.038013271	0.418145982	0.5324
183	pww60	6	12	0.038345052	0.011309734	0.067858401	0.0864
184	pww61	8	19.6	0.13171515	0.030171856	0.241374847	0.307328
185	pww62	8.5	17	0.082988081	0.022698007	0.192933059	0.24565
186	pww63	10	15.5	0.099444193	0.018869191	0.188691909	0.24025
187	pww64	10.3	20	0.156790994	0.031415927	0.323584043	0.412
188	pww65	13	29	0.331729343	0.066051986	0.858675812	1.0933
189	pww66	7.5	13	0.061002193	0.013273229	0.099549217	0.12675
190	pww67	9.2	22.8	0.205233933	0.040828138	0.375618871	0.4782528
191	pww68	12.3	21.4	0.235202995	0.035968094	0.44240756	0.5632908
192	pww69	16	28	0.604172856	0.061575216	0.985203456	1.2544
193	pww70	15.4	23	0.348047805	0.041547563	0.639832468	0.81466
194	pww71	8.4	16	0.079750309	0.020106193	0.168892021	0.21504
195	pww72	10	16.3	0.109680082	0.020867244	0.208672438	0.26569
196	pww73	5.6	11.4	0.029390793	0.010207035	0.057159393	0.0727776
197	pww74	8.2	12	0.041698494	0.011309734	0.092739815	0.11808
198	pww75	10.4	23.3	0.202828418	0.042638481	0.443440201	0.5646056
199	pww76	4.6	17.5	0.050415644	0.024052819	0.110642966	0.140875
200	pww77	9	21	0.162672606	0.034636059	0.311724531	0.3969
201	pww78	5.4	12	0.0248845	0.011309734	0.061072561	0.07776
202	pww79	8.6	23	0.184182902	0.041547563	0.35730904	0.45494
203	pww80	5.6	16	0.06267389	0.020106193	0.112594681	0.14336
204	pww81	10	30	0.324308031	0.070685835	0.706858347	0.9
205	pww82	9.3	17	0.099659322	0.022698007	0.211091464	0.26877
206	pww83	10.6	20.3	0.098010979	0.032365473	0.343074013	0.4368154
207	pww84	8.2	17.6	0.073422228	0.024328494	0.199493647	0.2540032
208	pww86	10	23	0.16282525	0.041547563	0.415475628	0.529
209	pww87	6.4	16	0.054447404	0.020106193	0.128679635	0.16384
210	pww88	9	17.9	0.108497205	0.025164943	0.226484483	0.288369
211	pww89	9.2	20	0.129081397	0.031415927	0.289026524	0.368
212	pww90	11.3	29.2	0.451779079	0.066966189	0.756717936	0.9634832
213	pww91	11	16	0.096577569	0.020106193	0.221168123	0.2816
214	pww92	15	22	0.244287486	0.038013271	0.570199067	0.726
215	pww93	16	23	0.308507198	0.041547563	0.664761005	0.8464
216	pww94	13.4	22	0.187797709	0.038013271	0.509377833	0.64856
217	pww95	9	16	0.081960869	0.020106193	0.180955737	0.2304
218	pww96	12	26	0.281567529	0.053092916	0.63711499	0.8112
219	pww97	10.5	16.2	0.114164395	0.020611989	0.216425889	0.275562
220	pww98	12	25	0.235994746	0.049087385	0.589048623	0.75
221	pww99	11.2	24.5	0.176213346	0.047143525	0.528007477	0.67228

222	pww100	10.5	19.6	0.12461875	0.030171856	0.316804486	0.403368
223	pww101	15.7	26	0.361352574	0.053092916	0.833558779	1.06132
224	pww102	10.4	19.4	0.140351131	0.029559245	0.307416151	0.3914144
225	pww103	12	30	0.296515067	0.070685835	0.848230016	1.08
226	pww104	12.6	30.8	0.349919441	0.074506011	0.938775743	1.1952864
227	pww105	12.4	33	0.3933907	0.08552986	1.060570264	1.35036
228	pww106	14	32	0.455912771	0.080424772	1.125946807	1.4336
229	pww107	8.2	15	0.046179038	0.017671459	0.144905961	0.1845
230	pww108	15	42.3	0.824047902	0.140530508	2.10795762	2.683935
231	pww109	12.4	21.3	0.15496422	0.035632729	0.441845843	0.5625756
232	pww110	10.5	17.3	0.096357769	0.023506182	0.246814907	0.3142545
233	pww111	14	21.4	0.2305702	0.035968094	0.50355332	0.641144
234	pww112	9.3	13	0.040926799	0.013273229	0.123441029	0.15717
235	pww113	21	83.6	6.108011877	0.548911635	11.52714433	14.676816
236	pww114	14	50	0.97145477	0.196349541	2.748893572	3.5
237	pww115	20	61	2.202324997	0.292246657	5.844933132	7.442
238	pww116	21.3	54.6	1.588923603	0.234139759	4.987176864	6.3498708
239	pww117	17	43.7	1.145584726	0.149986702	2.549773932	3.246473
240	pww118	21.2	53	1.757802537	0.220618344	4.677108895	5.95508
241	pww119	19.3	60.4	1.786666712	0.286525816	5.529948256	7.0409488
242	pww120	18.8	51	1.455382503	0.204282062	3.840502771	4.88988
243	pww121	16.3	31.3	0.441257214	0.076944673	1.254198165	1.5968947
244	pww122	16	26.3	0.299330234	0.054325206	0.869203289	1.106704
245	pww123	14	22.3	0.201305753	0.039057065	0.546798914	0.696206
246	pww124	15.8	34.5	0.607651544	0.093482016	1.477015859	1.880595
247	pww125	16.6	28.3	0.37801102	0.062901754	1.044169108	1.3294774
248	pww126	34	128	15.89806811	1.286796351	43.75107593	55.7056
249	pww127	29.3	94	8.904097937	0.693977817	20.33355004	25.88948
250	pww128	28.5	78.2	6.396677753	0.480289826	13.68826005	17.428434
251	pww129	24	58	2.569472755	0.264207942	6.340990612	8.0736
252	pww130	23.4	46.2	1.456198315	0.167638526	3.922741499	4.9945896
253	pww131	16	23	0.265894337	0.041547563	0.664761005	0.8464
254	pww132	25	64.2	3.603007444	0.323712849	8.092821215	10.3041
255	pww133	23.3	47.5	1.831581664	0.177205461	4.128887232	5.2570625
256	pww134	22	44.5	1.632743009	0.155528471	3.421626369	4.35655
257	pww135	24.7	62.5	3.411440597	0.306796158	7.577865092	9.6484375
258	pww136	15	20	0.189707064	0.031415927	0.471238898	0.6
259	pww137	24.3	65.4	3.671694826	0.335927361	8.163034869	10.3934988
260	pww138	26	55	2.788947608	0.237582944	6.177156555	7.865
261	pww139	25.6	78	5.732930674	0.477836243	12.23260781	15.57504
262	pww140	21	59	2.779737006	0.273397101	5.741339114	7.3101
263	pww141	17.4	38.4	0.841345416	0.115811672	2.015123086	2.5657344
264	pww142	13	29.2	0.414731161	0.066966189	0.870560457	1.108432
265	pww143	24	84.5	6.05984131	0.560793924	13.45905417	17.1366
266	pww144	16	36	0.741472614	0.101787602	1.628601632	2.0736

267	pww145	22.8	72.5	4.276918012	0.41282491	9.41240794	11.98425
268	pww146	25.8	84.4	6.91192259	0.559467386	14.43425856	18.3782688
269	pww147	11.3	17	0.101215584	0.022698007	0.256487478	0.32657
270	pww148	13	19.9	0.180940381	0.031102553	0.404333185	0.514813
271	pww149	17	42	1.125652242	0.138544236	2.355252012	2.9988
272	pww150	11	13.7	0.061415378	0.014741138	0.162152519	0.206459
273	pww151	12	24.2	0.265913765	0.045996058	0.551952696	0.702768
274	pww152	14	23	0.241889429	0.041547563	0.58166588	0.7406
275	pww153	9	18.3	0.104175976	0.026302199	0.236719792	0.301401
276	pww154	14	22	0.199254862	0.038013271	0.532185796	0.6776
277	pww155	16	20.2	0.176149761	0.032047387	0.512758187	0.652864
278	pww156	12.2	23.6	0.175945386	0.043743536	0.533671141	0.6794912
279	pww157	10	16	0.07445466	0.020106193	0.20106193	0.256
280	pww158	12	15.6	0.086466023	0.01911345	0.229361396	0.292032
281	pww159	14	24.1	0.248268104	0.045616711	0.63863395	0.813134
282	pww160	11.2	16.5	0.103930507	0.021382465	0.239483608	0.30492
283	pww161	12.2	25	0.235722783	0.049087385	0.5988661	0.7625
284	pww162	13	24.4	0.235089053	0.046759465	0.607873046	0.773968
285	pww163	16	40.7	0.738910099	0.13010042	2.081606726	2.650384
286	pww164	13.6	23	0.242571908	0.041547563	0.565046855	0.71944
287	pww165	13	24.7	0.227899748	0.047916357	0.622912635	0.793117
288	pww166	11.3	25	0.190178771	0.049087385	0.554687453	0.70625
289	pww167	14.2	26.2	0.335669454	0.053912872	0.765562776	0.9747448
290	pww168	16.1	27	0.383656661	0.057255526	0.92181397	1.17369
291	pww169	12.4	22.4	0.161214587	0.039408138	0.488660914	0.6221824
292	pww170	12	20	0.127530197	0.031415927	0.376991118	0.48
293	pww171	15.2	20.9	0.201817966	0.034306977	0.521466053	0.6639512
294	pww172	15	25.8	0.268665387	0.052279243	0.78418865	0.99846
295	pww173	12	16.8	0.109132663	0.022167078	0.266004933	0.338688
296	pww174	15.3	28.9	0.440642323	0.06559724	1.003637772	1.2778713
297	pww175	16	27.8	0.415746794	0.060698712	0.971179387	1.236544
298	pww176	17.7	28.5	0.474469425	0.063793966	1.129153195	1.4376825
299	pww177	19.5	39.6	0.771023311	0.123162998	2.401678469	3.057912
300	pww178	20.1	30.8	0.61558444	0.074506011	1.497570829	1.9067664
301	pww179	23.6	43	1.489269501	0.14522012	3.427194842	4.36364
302	pww180	16.3	24	0.34637654	0.045238934	0.737394628	0.93888
303	pww181	19	31.8	0.750342093	0.079422604	1.509029474	1.921356
304	pww182	12	12.8	0.064121862	0.012867964	0.154415562	0.196608
305	pww183	11.3	14.7	0.055134789	0.016971669	0.191779859	0.2441817
306	pww184	10.5	11	0.018133265	0.009503318	0.099784837	0.12705
307	pww185	12	18.9	0.156072366	0.028055208	0.336662494	0.428652
308	pww186	17.5	20.1	0.302506619	0.031730871	0.555290246	0.7070175
309	pww187	15.2	20	0.211935281	0.031415927	0.477522083	0.608
310	pww188	16.7	19.3	0.175879917	0.029255296	0.488563446	0.6220583
311	pww189	13.2	19.8	0.169680969	0.03079075	0.406437895	0.5174928

312	pww190	17.4	23	0.324291703	0.041547563	0.722927593	0.92046
313	pww191	14.4	16	0.111177941	0.020106193	0.289529179	0.36864
314	pww192	12.7	15.3	0.076497818	0.018385386	0.233494397	0.2972943
315	pww193	17.4	23.4	0.326179825	0.043005262	0.748291556	0.9527544
316	pww194	18	25	0.414663651	0.049087385	0.883572934	1.125
317	pww195	14.3	19.2	0.131714365	0.028952918	0.414026726	0.5271552
318	pww196	13	19.4	0.143228863	0.029559245	0.384270189	0.489268
319	pww197	15	22	0.233531456	0.038013271	0.570199067	0.726
320	pww198	13.2	17.1	0.107499078	0.022965828	0.303148926	0.3859812
321	pww199	14	19	0.15250352	0.028352874	0.396940232	0.5054
322	pww200	11.2	15.2	0.06017759	0.018145839	0.203233399	0.2587648
323	pww201	12	16	0.092609551	0.020106193	0.241274316	0.3072
324	pww202	17.3	31	0.587155351	0.075476764	1.305748009	1.66253
325	pww203	16	25	0.352677735	0.049087385	0.785398163	1
326	pww204	16.3	26.2	0.340897829	0.053912872	0.878779806	1.1188972
327	pww205	12.2	16	0.099660892	0.020106193	0.245295554	0.31232
328	pww206	17.3	28.3	0.467505769	0.062901754	1.088200336	1.3855397
329	pww207	16.1	30.2	0.570543377	0.071631454	1.153266411	1.4683844
330	pww208	20.4	37.3	0.949634557	0.109271661	2.229141886	2.8382316
331	pww209	19.3	34.7	0.789986124	0.094569007	1.825181844	2.3238937
332	pww210	16.4	31	0.534296591	0.075476764	1.237818921	1.57604
333	pww211	17	24.4	0.394784389	0.046759465	0.794910906	1.012112
334	pww212	20.3	43.4	1.305045623	0.147934456	3.003069466	3.8236268
335	pww213	19.4	37	0.903110276	0.107521009	2.085907566	2.65586
336	pww214	19.2	35.9	0.498250765	0.101222901	1.943479693	2.4745152
337	pww215	20.5	43.1	1.183105607	0.145896348	2.990875139	3.8081005
338	pww216	23.4	54.1	2.108953761	0.22987112	5.378984205	6.8487354
339	ade01	11.5	16.8	0.146589541	0.022167078	0.254921394	0.324576
340	ade02	20.72	37.8	1.199396541	0.112220831	2.325215622	2.96055648
341	ade03	17.4	46.5	1.53625055	0.169822718	2.954915291	3.762315
342	ade04	18.7	27.8	0.619129657	0.060698712	1.135065908	1.4452108
343	ade05	32.8	65.9	4.746393984	0.3410835	11.18753879	14.2444168
344	ade06	33.2	73	6.276489979	0.418538681	13.89548422	17.69228
345	ade07	30.6	58.9	4.375450948	0.272471116	8.337616157	10.6157826
346	adec01	12.7	23.7	0.271421836	0.044115029	0.560260874	0.7133463
347	adec02	28.6	51.3	3.274926013	0.206692449	5.911404049	7.5266334
348	adec03	19.9	25	0.472585791	0.049087385	0.976838966	1.24375
349	adec04	19.9	29.4	0.838286848	0.067886676	1.350944845	1.7200764
350	adec05	20.65	23	0.502567026	0.041547563	0.857957173	1.092385
351	adec07	18.75	15.5	0.207728677	0.018869191	0.353797329	0.45046875
352	adec08	21.9	26	0.601147196	0.053092916	1.162734857	1.48044
353	adec11	12.56	16.5	0.138982017	0.021382465	0.26856376	0.341946
354	adec15	22.1	38.5	1.314582347	0.116415643	2.572785705	3.2757725
355	adec16	21.04	37.5	1.166728974	0.110446617	2.323796816	2.95875
356	adec17	32.35	44.3	2.177899745	0.154133604	4.986222095	6.34865515

357	adec18	48.65	32.9	1.563963153	0.085012283	4.135847549	5.26592465
358	adec19	51.45	42.1	2.875338656	0.139204756	7.16208469	9.11904945
359	adec20	24.8	38.2	1.320902102	0.114608442	2.842289352	3.6189152
360	adec21	57.03	52.3	2.842750357	0.214829174	12.25170781	15.5993589
361	adec22	24.85	38.6	1.416755447	0.117021185	2.907976441	3.7025506
362	adec23	18.7	31.9	0.960422471	0.079922903	1.494558277	1.9029307
363	adec24	18.7	31.9	0.960422471	0.079922903	1.494558277	1.9029307
364	adec25	28.9	40	1.758565043	0.125663706	3.631681108	4.624
365	adec26	31.03	60.3	4.266146083	0.285577841	8.8614804	11.2827873
366	adec27	28.15	37.4	1.460907498	0.109858354	3.092512651	3.9375094
367	adec28	55.3	50	3.137037685	0.196349541	10.85812961	13.825
368	adec29	29.72	51.3	2.821744492	0.206692449	6.142899592	7.82138268
369	adec30	49.1	54.3	3.266064942	0.231573863	11.37027668	14.4770859
370	adec31	66.8	56	3.768954077	0.246300864	16.45289772	20.94848
371	adec32	52.65	31	0.971700158	0.075476764	3.973851598	5.059665
372	adw01	24.9	35.6	1.478183311	0.099538222	2.478501719	3.1557264
373	adw02	37.8	63.4	6.120486208	0.315695504	11.93329006	15.1939368
374	adw03	20.8	26.1	0.734993556	0.053502108	1.112843852	1.4169168
375	adw04	38.3	54.2	4.622640151	0.230721706	8.836641343	11.2511612
376	adw05	27.9	44.4	2.232930056	0.154830252	4.31976404	5.5000944
377	adw06	8.4	15.5	0.093948936	0.018869191	0.158501203	0.20181
378	adw08	39.5	82	9.91628686	0.528101725	20.86001814	26.5598
379	adwc01	38.6	49	3.723356142	0.188574099	7.278960223	9.26786
380	adwc02	42.3	55	5.131366138	0.237582944	10.04975855	12.79575
381	adwc03	13.8	14.7	0.135163806	0.016971669	0.234209031	0.2982042
382	adwc04	46.6	67.5	7.339489887	0.357847038	16.67567198	21.232125
383	adwc05	42.3	77.4	8.394678059	0.47051319	19.90270794	25.3409148
384	adwc06	36.5	39.5	2.602202385	0.122541748	4.472773818	5.6949125
385	psec01	34.86	59	4.8661657	0.273397101	9.53062293	12.134766
386	psec02	20.44	35.2	1.094367066	0.097313974	1.989097629	2.53259776
387	psec05	15.62	20.2	0.26684223	0.032047387	0.50058018	0.63735848
388	psec06	20.08	40	1.20273919	0.125663706	2.523327219	3.2128
389	psec07	36.15	52.3	3.482030147	0.214829174	7.766074649	9.88807335
390	psec08	25.95	27.3	0.774571595	0.05853494	1.518981686	1.93402755
391	psec09	25.2	22.5	0.472797599	0.039760782	1.001971707	1.27575
392	psec10	30.8	42.3	1.87767627	0.140530508	4.328339646	5.5110132
393	psec11	14.18	16.5	0.165102763	0.021382465	0.303203354	0.3860505
394	psec12	28.3	39.4	1.53984739	0.121922069	3.450394561	4.3931788
395	psec13	14.87	15	0.130968537	0.017671459	0.262774591	0.334575
396	psec14	22.41	20.8	0.41662656	0.033979466	0.761479836	0.96954624
397	psec16	14.97	14.8	0.107362349	0.017203361	0.25753432	0.32790288
398	psec18	19.8	21.3	0.378038843	0.035632729	0.70552804	0.8983062
399	psec19	22.8	29.6	0.686314748	0.068813445	1.568946557	1.9976448
400	psec20	28.35	46.2	2.220080923	0.167638526	4.7525522	6.0511374
401	psec21	10.7	10	0.01824963	0.007853982	0.084037603	0.107

402	psec22	23.8	29.5	0.807256605	0.068349275	1.626712749	2.071195
403	psec24	28.16	49	2.545480691	0.188574099	5.310246629	6.761216
404	psec25	30.85	65	4.201513264	0.331830724	10.23697784	13.034125
405	psec26	39.7	75.3	9.531324031	0.445327827	17.67951474	22.5102573
406	psec27	32.8	44.5	2.321451544	0.155528471	5.101333859	6.49522
407	psec28	33.3	39.8	2.032063803	0.124410211	4.142860015	5.2748532
408	psec29	28.75	40	1.999646078	0.125663706	3.612831552	4.6
409	psec30	34.7	55.3	3.863770369	0.240181827	8.334309395	10.6115723
410	psec31	35.7	45.8	3.084966579	0.16474826	5.881512894	7.4885748
411	psec32	38.15	54.8	4.276422056	0.23585821	8.997990714	11.4565976
412	psw01	31.9	42.5	2.247760066	0.141862543	4.52541513	5.7619375
413	psw02	32.8	69.3	5.812673044	0.377186683	12.37172319	15.7521672
414	psw03	46.5	87.3	13.65888883	0.598574717	27.83372433	35.4389985
415	psw04	34.3	59	4.191450669	0.273397101	9.377520553	11.93983
416	psw05	19.8	23	0.483692927	0.041547563	0.822641744	1.04742
417	psw06	12.9	15.5	0.142818451	0.018869191	0.243412562	0.3099225
418	psw08	23.4	38	1.393831431	0.113411495	2.653828978	3.37896
419	pswc01	48.8	81	11.52829878	0.515299735	25.14662707	32.01768
420	pswc02	10.4	17	0.133388215	0.022698007	0.236059272	0.30056
421	pswc03	27.3	38	1.83920336	0.113411495	3.096133808	3.94212
422	pswc04	43.4	63.5	6.508100701	0.316692174	13.74444037	17.499965
423	pswc05	25.5	46.5	2.142622231	0.169822718	4.330479306	5.5137375
424	pswc07	45.7	57.5	5.604516509	0.259672268	11.86702264	15.1095625
425	pswc08	14.2	27	0.528043333	0.057255526	0.813028471	1.03518
426	psw09	22	32.5	1.035949449	0.082957681	1.825068982	2.32375
427	psw10	40	85.5	7.970598003	0.574145692	22.9658277	29.241
428	psw11	32	48.9	2.829294689	0.187805194	6.009766215	7.651872
429	psw12	44	74	6.616100754	0.430084034	18.92369751	24.0944
430	psw13	35	65.2	5.447341087	0.333875901	11.68565653	14.87864
431	psw14	35	36.9	1.650496634	0.106940599	3.742920976	4.765635
432	psw15	19.3	45	1.477928082	0.159043128	3.069532372	3.90825
433	psw16	24.4	70.6	4.151098905	0.391470719	9.551885543	12.1618384
434	psw17	20.7	47	1.939720731	0.173494454	3.591335204	4.57263
435	psw18	19.4	36.2	0.823139373	0.102921717	1.996681308	2.5422536
436	psw19	36.3	69.6	4.60898949	0.380459437	13.81067755	17.5843008
437	psw20	28.7	57.9	2.662923413	0.263297666	7.556643005	9.6214167
438	psw21	30	67	5.702920458	0.352565236	10.57695707	13.467
439	psw22	38	55	4.020903372	0.237582944	9.028151888	11.495
440	psw23	30.5	69	4.469205615	0.373928066	11.404806	14.52105
441	psw24	31	54.5	2.690652089	0.233282889	7.231769574	9.207775
442	psw25	33	65	3.918821309	0.331830724	10.95041389	13.9425
443	psw26	42	67	4.774218913	0.352565236	14.80773989	18.8538
444	psw27	43.7	65	5.056709733	0.331830724	14.50100264	18.46325
445	psw28	44	75	6.234599201	0.441786467	19.43860454	24.75
446	psw29	39	74	7.871302187	0.430084034	16.77327734	21.3564

447	psw30	49	74	6.618694069	0.430084034	21.07411768	26.8324
448	psw31	56	66	7.334946347	0.34211944	19.15868864	24.3936
449	psw32	41.5	86	9.755593634	0.580880482	24.10653999	30.6934
450	psw33	41.4	76	7.008484823	0.453645979	18.78094354	23.91264
451	psw34	40	66	5.472266154	0.34211944	13.6847776	17.424
452	psw35	43	73	4.747888249	0.418538681	17.99716329	22.9147
453	psw36	10.2	17.5	0.139818007	0.024052819	0.245338751	0.312375
454	psw37	24	82.3	6.117037503	0.531972953	12.76735086	16.255896
455	psw38	27	99.5	9.273938156	0.777563817	20.99422305	26.730675
456	psw39	26.3	74	5.209930115	0.430084034	11.3112101	14.40188
457	psw40	25.3	68.7	4.239919873	0.370683586	9.37829472	11.9408157
458	psw41	23.4	86	6.158016209	0.580880482	13.59260327	17.30664
459	psw42	24.7	74.2	5.01539423	0.432411954	10.68057527	13.5989308
460	psw43	22.1	62.8	3.051576188	0.309748469	6.845441171	8.7158864
461	lge01	19.39	34.5	0.957042837	0.093482016	1.812616298	2.30789475
462	lge02	20.45	44.5	1.775821593	0.155528471	3.180557238	4.04961125
463	lge03	14.26	26.9	0.441865343	0.056832197	0.810427122	1.03186786
464	lge05	29.31	56.3	3.368623221	0.24894687	7.296632773	9.29036139
465	lge06	31.3	58.3	3.403125161	0.266948196	8.355478546	10.6385257
466	lge07	30.2	63.5	4.218298206	0.316692174	9.564103668	12.177395
467	lge08	8.9	13.7	0.053889191	0.014741138	0.131196129	0.1670441
468	lgec01	19.6	46	1.368093781	0.166190251	3.257328927	4.14736
469	lgec02	21.5	53	2.033022698	0.220618344	4.743294398	6.03935
470	lgec03	15.1	24.6	0.363223654	0.047529155	0.717690244	0.9137916
471	lgec04	20.88	37	1.098969228	0.107521009	2.245038659	2.858472
472	lgec05	12.9	13	0.068729694	0.013273229	0.171224654	0.21801
473	lgec06	17.02	57.1	1.733829971	0.256072003	4.358345484	5.54921782
474	lgec07	15	41.9	1.01965164	0.137885287	2.068279304	2.633415
475	lgwc01	12	18.8	0.187518524	0.027759113	0.333109352	0.424128
476	lgwc02	21	45	1.507973853	0.159043128	3.33990569	4.2525
477	lgwc03	29.3	29.8	1.295933382	0.069746499	2.043572406	2.6019572
478	lgwc04	34.2	65	4.779314009	0.331830724	11.34861076	14.4495
479	lgwc05	35.9	58	4.089199863	0.264207942	9.485065124	12.07676
480	lgwc06	31	39.8	1.740299192	0.124410211	3.856716531	4.910524
481	lgwc07	46.98	73	7.771535639	0.418538681	19.66294725	25.035642
482	lgwc08	8	10	0.072422373	0.007853982	0.062831853	0.08
483	lgw01	25.7	49.1	2.735764856	0.189344575	4.866155568	6.1957817
484	lgw02	27.3	54.1	3.041041163	0.22987112	6.275481572	7.9901913
485	lgw03	22.3	25.5	0.646347714	0.051070516	1.138872497	1.4500575
486	lgw05	36.7	83.2	9.674329864	0.543671458	19.95274252	25.4046208
487	lgw06	12.9	19.8	0.200193708	0.03079075	0.39720067	0.5057316
488	lgw07	23.5	37.6	1.222722741	0.111036451	2.609356593	3.322336
489	lgw08	33.93	69.9	5.841984091	0.383746328	13.02051291	16.5782319
490	tde01	36.6	67.3	5.261418566	0.355729605	13.01970353	16.5772014
491	tde02	31.02	38	1.460434861	0.113411495	3.518024569	4.479288

492	tde03	35.3	81	6.215342326	0.515299735	18.19008065	23.16033
493	tde04	36.55	45.5	2.523334832	0.162597055	5.942922352	7.56676375
494	tde05	29.52	54	3.086679845	0.229022104	6.760732523	8.608032
495	tde06	14.1	26	0.368229579	0.053092916	0.748610113	0.95316
496	tde07	11.3	15.7	0.125762664	0.019359279	0.218759856	0.2785337
497	tdec01	29.55	56.5	3.140540624	0.250718729	7.408738433	9.43309875
498	tdec02	23	34	0.972963801	0.090792028	2.088216637	2.6588
499	tdec03	35	71	6.964498285	0.395919214	13.8571725	17.6435
500	tdec04	27.3	48	2.514826117	0.180955737	4.940091616	6.28992
501	tdec05	28.55	47.3	2.554924699	0.175716346	5.01670167	6.38746295
502	tdec06	27	45	2.134944867	0.159043128	4.294164458	5.4675
503	tdec07	24.6	24	0.555528384	0.045238934	1.112877782	1.41696
504	tdec08	25.2	22	0.523168201	0.038013271	0.957934432	1.21968
505	tdec09	32.7	75.4	5.870714905	0.446511422	14.60092351	18.5904732
506	tdec10	36	86.5	9.075542558	0.587654541	21.15556347	26.9361
507	tdec11	33.7	63	3.686736391	0.311724531	10.5051167	13.37553
508	tdec12	26.3	28.7	0.802280421	0.064692461	1.701411733	2.1663047
509	tdec13	34.3	52.2	3.20821062	0.214008433	7.340489257	9.3462012
510	tdec14	32.3	58.3	4.331624883	0.266948196	8.622426742	10.9784147
511	tdec15	31.3	57.5	3.811423087	0.259672268	8.127741981	10.3485625
512	tdec16	25.3	42	1.612550626	0.138544236	3.505169171	4.46292
513	tdec17	29.4	46.9	1.957068704	0.172756965	5.079054783	6.4668534
514	tdec18	21.6	35.8	1.067261767	0.10065977	2.174251037	2.7683424
515	tdec19	19.45	22.7	0.444718405	0.040470782	0.787156709	1.00223905
516	tdec20	29.7	37.5	1.580749126	0.110446617	3.280264517	4.1765625
517	tdec21	35.6	74.8	6.730652309	0.439433414	15.64382954	19.9183424
518	tdec22	36.1	75	7.197809115	0.441786467	15.94849146	20.30625
519	tdec23	35.8	61.3	4.633258308	0.295128282	10.56559251	13.4525302
520	tdec28	15.2	20	0.289943898	0.031415927	0.477522083	0.608
521	tdec29	14.6	18.3	0.206236635	0.026302199	0.384012107	0.4889394
522	tdec30	13.6	16.3	0.168537707	0.020867244	0.283794516	0.3613384
523	tdec31	13.9	14.7	0.107751191	0.016971669	0.235906198	0.3003651
524	tdec32	40.6	64.9	5.21467086	0.330810492	13.43090597	17.1007606
525	tdw01	23.2	33.5	1.135850828	0.088141309	2.044878366	2.60362
526	tdw02	22.9	27.5	0.593736665	0.059395736	1.360162357	1.7318125
527	tdw03	31.6	47	2.911417256	0.173494454	5.482424756	6.98044
528	tdw04	8.6	19.5	0.150392949	0.029864765	0.25683698	0.327015
529	tdw05	35.3	95	10.92360789	0.708821842	25.02141104	31.85825
530	tdw07	30.6	56.5	3.71350107	0.250718729	7.671993099	9.768285
531	tdw08	30.6	69	5.218612075	0.373928066	11.44219881	14.56866
532	tdwc01	30.5	37	1.798330846	0.107521009	3.279390761	4.17545
533	tdwc02	17.9	18	0.24656114	0.0254469	0.455499519	0.57996
534	tdwc03	44.5	89.5	11.81685746	0.629123564	27.99599859	35.6456125
535	tdwc04	46.4	69.5	8.420746233	0.379366948	17.60262638	22.41236
536	tdwc05	34.8	47.4	3.429788227	0.176460118	6.140812098	7.8187248

537	tdwc06	42.7	58	5.835085848	0.264207942	11.28167913	14.36428
538	tdwc07	29.8	29.5	1.102403791	0.068349275	2.0368084	2.593345
539	tdw09	25.14	105	6.750827758	0.865901475	21.76876309	27.71685
540	tdw10	7.5	21.5	0.14149372	0.03630503	0.272287726	0.3466875
541	tdw11	8	12.7	0.049332429	0.012667687	0.101341496	0.129032
542	tdw12	20	51.5	2.002121656	0.208307228	4.166144558	5.3045
543	tdw13	23	62	3.343592775	0.301907054	6.943862242	8.8412
544	tdw14	21	56	2.346031083	0.246300864	5.172318145	6.5856
545	tdw15	23	46	2.000308838	0.166190251	3.822375782	4.8668
546	tdw16	22	50	2.413907763	0.196349541	4.319689899	5.5
547	tdw17	32	70	4.097460357	0.3848451	12.3150432	15.68
548	tdw18	28	52	3.29507991	0.212371663	5.946406575	7.5712
549	tdw19	39	110	14.53471499	0.950331778	37.06293933	47.19
550	tdw20	11.5	27.7	0.354556887	0.060262816	0.69302238	0.8823835
551	tdw21	20.7	117	10.08938058	1.075131546	22.255223	28.33623
552	tdw22	25	136	15.18178732	1.452672443	36.31681108	46.24
553	tdw23	24	110	10.2817002	0.950331778	22.80796267	29.04
554	tdw24	17.3	72.2	2.975348688	0.409415496	7.082888084	9.0182132
555	tdw25	19.1	87.6	5.317951188	0.602695701	11.51148789	14.6568816
556	tdw26	16.4	61.5	2.111685948	0.29705722	4.871738414	6.20289
557	ccw01	42.2	52.4	3.487938415	0.215651486	9.100492714	11.5871072
558	ccw02	45.7	70	7.400017176	0.3848451	17.58742107	22.393
559	ccw03	32.94	37.5	1.634976536	0.110446617	3.638111555	4.6321875
560	ccw04	35.3	49	2.363235428	0.188574099	6.656665696	8.47553
561	ccw05	22.1	25.3	0.547507377	0.050272551	1.111023378	1.4145989
562	ccw06	32.95	28.7	0.962796995	0.064692461	2.131616601	2.71405855
563	ccw07	25.79	22.5	0.590341853	0.039760782	1.025430568	1.30561875
564	ccw08	23.8	19.2	0.386629176	0.028952918	0.689079446	0.8773632
565	ccw09	44.11	42.4	2.660952234	0.14119574	6.228144101	7.92991936
566	ccw10	30.5	30	1.020279783	0.070685835	2.155917959	2.745
567	ccw11	43.79	56	4.744403683	0.246300864	10.78551484	13.732544
568	ccw12	57.5	72.3	9.718144112	0.410550397	23.6066478	30.0569175
569	ccw14	16.28	17.3	0.192758585	0.023506182	0.382680637	0.48724412
570	ccw15	12.75	15.2	0.102480881	0.018145839	0.231359449	0.294576
571	ccw16	51	59	6.748561038	0.273397101	13.94325213	17.7531
572	ccw17	49	64	6.512782634	0.321699088	15.7632553	20.0704
573	ccw18	55	62.5	7.416341496	0.306796158	16.87378867	21.484375
574	ccw19	65	88	14.57551101	0.608212338	39.53380195	50.336
575	ccw20	46	44	2.9600213	0.152053084	6.994441884	8.9056
576	ccw21	21	16.5	0.24027569	0.021382465	0.449031765	0.571725
577	ccw22	42.29	46.5	3.211510883	0.169822718	7.181802739	9.14415525
578	ccw23	65	74.5	12.16622768	0.435915616	28.33451502	36.076625
579	ccw24	56	61.5	7.190834894	0.29705722	16.63520434	21.1806
580	ccw25	38.8	35	1.551500383	0.096211275	3.732997471	4.753
581	ccw26	36	34	1.685647957	0.090792028	3.268512997	4.1616

582	ccw27	33	36	1.768935411	0.101787602	3.358990865	4.2768
583	ccw29	16	17.6	0.198472019	0.024328494	0.389255896	0.495616