R Notebook

This is an exploratory study via logistic regressions

```
library(caret)
```

```
## Loading required package: ggplot2
```

```
## Loading required package: lattice
```

```
action_count <- read.table(file='../data/beerslaw/logistic_regression/action_count.tsv', header=TRUE, s
```

General Logistic Regression

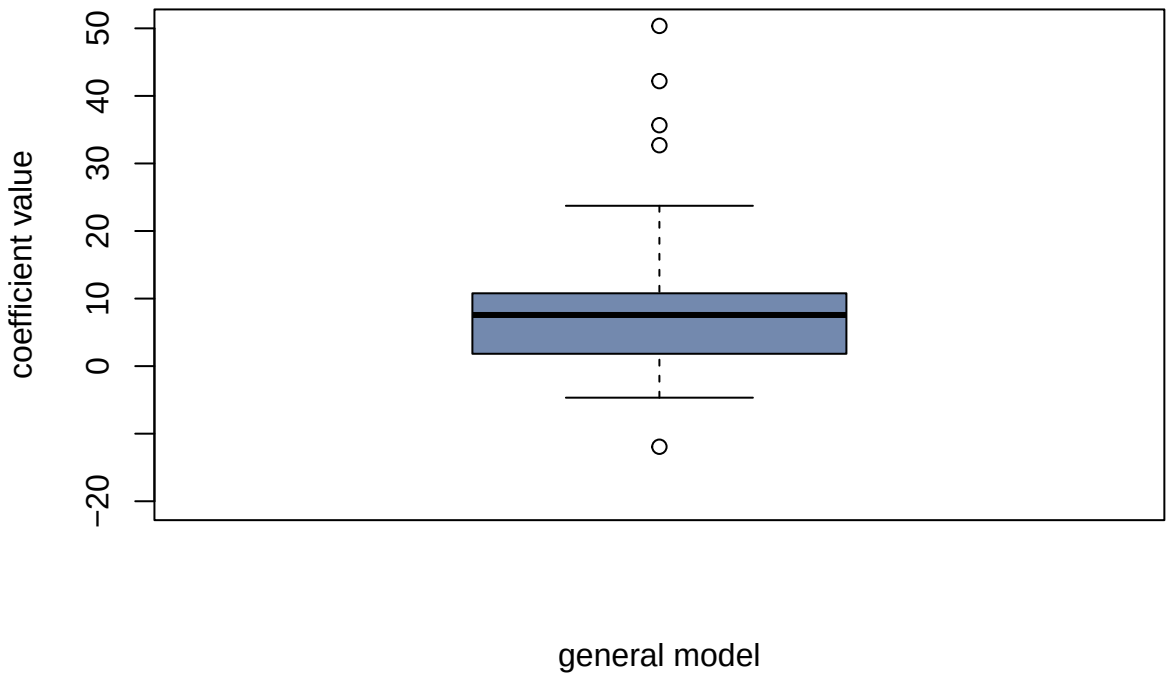
We start with a general Logistic regression.

```
general_model <- glm(
      formula = binconcepts ~
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wav
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(general_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
```

```
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0954  -0.7657  -0.3351   0.8479   2.1900
##
## Coefficients: (1 not defined because of singularities)
##                              Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 -11.9327    22.8977  -0.521    0.602
## greengreen_other              9.1993    31.2747   0.294    0.769
## greenred_other                7.8738    24.4476   0.322    0.747
## notgreennotred_other         -4.1484    24.5815  -0.169    0.866
## noobserved_other             -2.6140    23.2061  -0.113    0.910
## greengreen_concentration      7.5711    23.1600   0.327    0.744
## greenred_concentration        6.3760    22.7572   0.280    0.779
## notgreennotred_concentration  1.5372    22.8766   0.067    0.946
## noobserved_concentration      7.3637    22.9616   0.321    0.748
## greengreen_width             -3.8923    28.5705  -0.136    0.892
## greenred_width               -0.4738    22.5335  -0.021    0.983
## notgreennotred_width         10.5586    23.5292   0.449    0.654
## noobserved_width              3.6381    22.9122   0.159    0.874
## greengreen_wavelength        23.7342    30.3570   0.782    0.434
## greenred_wavelength           9.1825    23.1052   0.397    0.691
## notgreennotred_wavelength     3.7015    23.2362   0.159    0.873
## noobserved_wavelength        10.7804    22.7972   0.473    0.636
## greengreen_solution          50.3587    39.1919   1.285    0.199
## greenred_solution             6.9030    22.8899   0.302    0.763
## notgreennotred_solution      -4.6717    23.8902  -0.196    0.845
## noobserved_solution           9.2792    22.9737   0.404    0.686
## greengreen_pdf                9.6708    29.0826   0.333    0.739
## greenred_pdf                  1.8285    23.3615   0.078    0.938
## notgreennotred_pdf           15.7118    24.5614   0.640    0.522
## noobserved_pdf                4.6093    23.7670   0.194    0.846
## greengreen_break             42.1903    32.6282   1.293    0.196
## greenred_break               35.6631    25.9076   1.377    0.169
## notgreennotred_break         32.6993    26.3461   1.241    0.215
## noobserved_break             21.8604    25.5226   0.857    0.392
## concentrationlab                 NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 255.44  on 225  degrees of freedom
## AIC: 313.44
##
## Number of Fisher Scoring iterations: 5
```

```
general_coeffs = coef(general_model)
boxplot(
  general_coeffs,
  xlab='general model',
  ylim=c(-20, 50), ylab='coefficient value', col='#7389AE'
)
```



Simple Demographics

Language

Language had a great discrepancy in the predictive task

```
language_model <- glm(
      formula = binconcepts ~
                french + german +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(language_model)
```

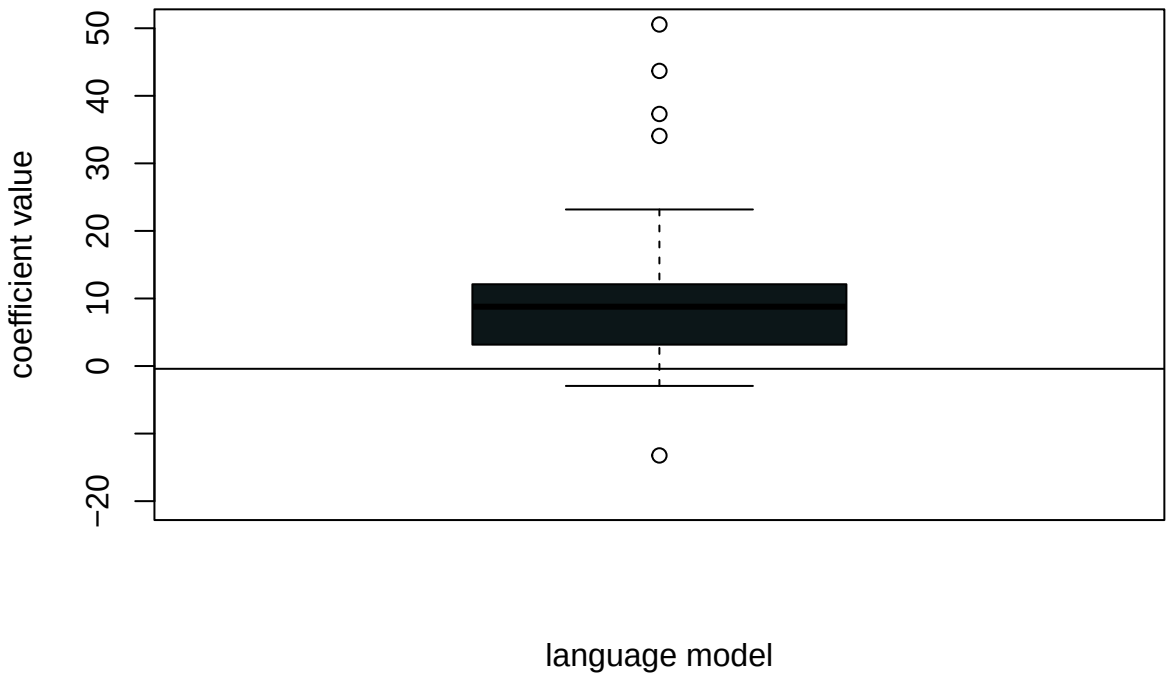
```
##
```

```
## Call:
## glm(formula = binconcepts ~ french + german + greengreen_other +
##     greenred_other + notgreennotred_other + noobserved_other +
##     greengreen_concentration + greenred_concentration + notgreennotred_concentration +
##     noobserved_concentration + greengreen_width + greenred_width +
##     notgreennotred_width + noobserved_width + greengreen_wavelength +
##     greenred_wavelength + notgreennotred_wavelength + noobserved_wavelength +
##     greengreen_solution + greenred_solution + notgreennotred_solution +
##     noobserved_solution + greengreen_pdf + greenred_pdf + notgreennotred_pdf +
##     noobserved_pdf + greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0803  -0.7941  -0.3484   0.8646   2.1620
##
## Coefficients: (2 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -13.2357    24.4630  -0.541    0.588
## french                        -0.4114     0.3597  -1.144    0.253
## german                            NA         NA      NA       NA
## greengreen_other              10.8024    32.5456   0.332    0.740
## greenred_other                 9.1657    26.0508   0.352    0.725
## notgreennotred_other          -2.1841    26.0420  -0.084    0.933
## noobserved_other              -1.4747    24.7254  -0.060    0.952
## greengreen_concentration       8.8464    24.6354   0.359    0.720
## greenred_concentration         7.7589    24.2962   0.319    0.749
## notgreennotred_concentration   3.1669    24.4186   0.130    0.897
## noobserved_concentration       8.7221    24.4996   0.356    0.722
## greengreen_width              -2.9452    29.8451  -0.099    0.921
## greenred_width                 0.9180    23.9995   0.038    0.969
## notgreennotred_width          11.9214    25.0362   0.476    0.634
## noobserved_width               5.0318    24.4459   0.206    0.837
## greengreen_wavelength         21.5969    31.5556   0.684    0.494
## greenred_wavelength           10.4944    24.6231   0.426    0.670
## notgreennotred_wavelength      5.2732    24.7515   0.213    0.831
## noobserved_wavelength         12.1049    24.3396   0.497    0.619
## greengreen_solution           50.5579    40.0902   1.261    0.207
## greenred_solution              8.0245    24.3886   0.329    0.742
## notgreennotred_solution       -2.5482    25.3960  -0.100    0.920
## noobserved_solution           10.9082    24.5290   0.445    0.657
## greengreen_pdf                10.3609    30.2387   0.343    0.732
## greenred_pdf                   4.0635    24.9271   0.163    0.871
## notgreennotred_pdf            17.9780    26.0260   0.691    0.490
## noobserved_pdf                 6.2041    25.2752   0.245    0.806
## greengreen_break              43.6858    33.8193   1.292    0.196
## greenred_break                37.3098    27.5262   1.355    0.175
## notgreennotred_break          34.0607    27.8270   1.224    0.221
## noobserved_break              23.1763    27.0705   0.856    0.392
## concentrationlab                  NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
```

```
## Residual deviance: 254.12  on 224  degrees of freedom
## AIC: 314.12
##
## Number of Fisher Scoring iterations: 5
```

```
language_coeffs = coef(language_model)
```

```
language_coeffs = coef(language_model)
boxplot(
  language_coeffs,
  xlab='language model',
  ylim=c(-20, 50), ylab='coefficient value', col='#0C1618'
)
abline(h=language_coeffs['french'])
```



French

```
language_model <- glm(
      formula = binconcepts ~
                french +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
```

```
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(language_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ french + greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0803  -0.7941  -0.3484   0.8646   2.1620
##
## Coefficients: (1 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -13.2357    24.4630  -0.541    0.588
## french                        -0.4114     0.3597  -1.144    0.253
## greengreen_other              10.8024    32.5456   0.332    0.740
## greenred_other                 9.1657    26.0508   0.352    0.725
## notgreennotred_other          -2.1841    26.0420  -0.084    0.933
## noobserved_other              -1.4747    24.7254  -0.060    0.952
## greengreen_concentration       8.8464    24.6354   0.359    0.720
## greenred_concentration         7.7589    24.2962   0.319    0.749
## notgreennotred_concentration   3.1669    24.4186   0.130    0.897
## noobserved_concentration       8.7221    24.4996   0.356    0.722
## greengreen_width              -2.9452    29.8451  -0.099    0.921
## greenred_width                 0.9180    23.9995   0.038    0.969
## notgreennotred_width          11.9214    25.0362   0.476    0.634
## noobserved_width               5.0318    24.4459   0.206    0.837
## greengreen_wavelength         21.5969    31.5556   0.684    0.494
## greenred_wavelength           10.4944    24.6231   0.426    0.670
## notgreennotred_wavelength      5.2732    24.7515   0.213    0.831
## noobserved_wavelength         12.1049    24.3396   0.497    0.619
## greengreen_solution           50.5579    40.0902   1.261    0.207
## greenred_solution              8.0245    24.3886   0.329    0.742
## notgreennotred_solution       -2.5482    25.3960  -0.100    0.920
## noobserved_solution           10.9082    24.5290   0.445    0.657
## greengreen_pdf                10.3609    30.2387   0.343    0.732
## greenred_pdf                   4.0635    24.9271   0.163    0.871
```

```
## notgreennotred_pdf            17.9780    26.0260   0.691    0.490
## noobserved_pdf                 6.2041    25.2752   0.245    0.806
## greengreen_break              43.6858    33.8193   1.292    0.196
## greenred_break                37.3098    27.5262   1.355    0.175
## notgreennotred_break          34.0607    27.8270   1.224    0.221
## noobserved_break              23.1763    27.0705   0.856    0.392
## concentrationlab                   NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 254.12  on 224  degrees of freedom
## AIC: 314.12
##
## Number of Fisher Scoring iterations: 5
```

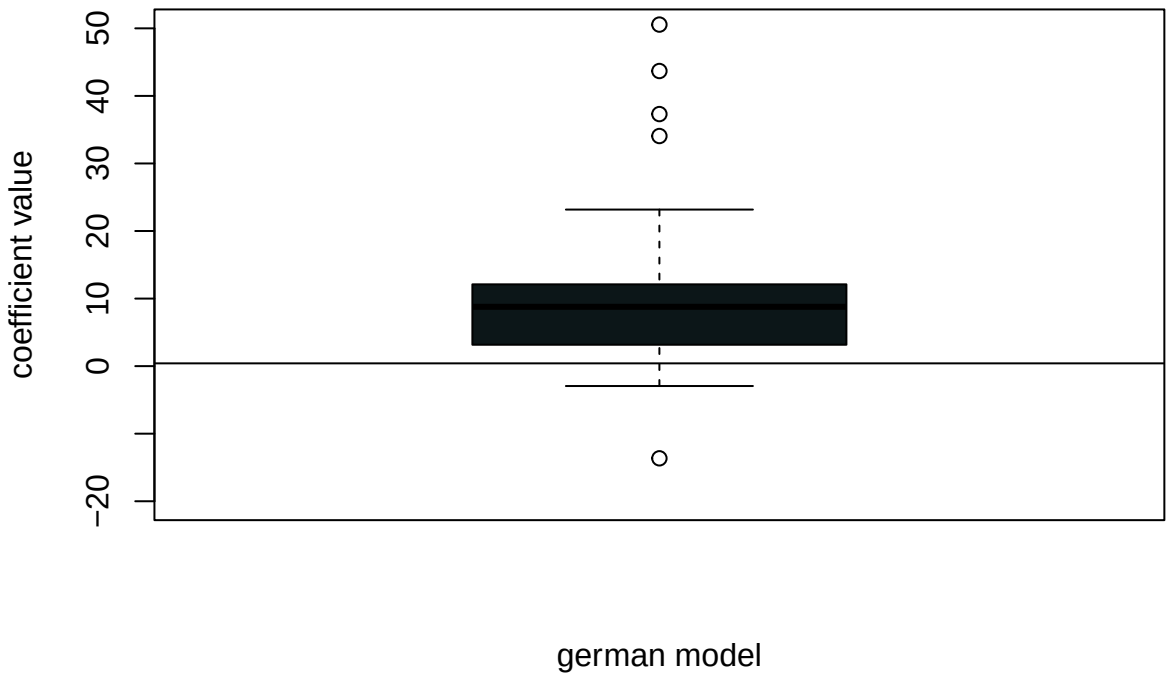
German

```
german_model <- glm(
      formula = binconcepts ~
                german +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(language_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ french + greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0803  -0.7941  -0.3484   0.8646   2.1620
##
## Coefficients: (1 not defined because of singularities)
```

```
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -13.2357    24.4630  -0.541    0.588
## french                        -0.4114     0.3597  -1.144    0.253
## greengreen_other              10.8024    32.5456   0.332    0.740
## greenred_other                 9.1657    26.0508   0.352    0.725
## notgreennotred_other          -2.1841    26.0420  -0.084    0.933
## noobserved_other              -1.4747    24.7254  -0.060    0.952
## greengreen_concentration       8.8464    24.6354   0.359    0.720
## greenred_concentration         7.7589    24.2962   0.319    0.749
## notgreennotred_concentration   3.1669    24.4186   0.130    0.897
## noobserved_concentration       8.7221    24.4996   0.356    0.722
## greengreen_width              -2.9452    29.8451  -0.099    0.921
## greenred_width                 0.9180    23.9995   0.038    0.969
## notgreennotred_width          11.9214    25.0362   0.476    0.634
## noobserved_width               5.0318    24.4459   0.206    0.837
## greengreen_wavelength         21.5969    31.5556   0.684    0.494
## greenred_wavelength           10.4944    24.6231   0.426    0.670
## notgreennotred_wavelength      5.2732    24.7515   0.213    0.831
## noobserved_wavelength         12.1049    24.3396   0.497    0.619
## greengreen_solution           50.5579    40.0902   1.261    0.207
## greenred_solution              8.0245    24.3886   0.329    0.742
## notgreennotred_solution       -2.5482    25.3960  -0.100    0.920
## noobserved_solution           10.9082    24.5290   0.445    0.657
## greengreen_pdf                10.3609    30.2387   0.343    0.732
## greenred_pdf                   4.0635    24.9271   0.163    0.871
## notgreennotred_pdf            17.9780    26.0260   0.691    0.490
## noobserved_pdf                 6.2041    25.2752   0.245    0.806
## greengreen_break              43.6858    33.8193   1.292    0.196
## greenred_break                37.3098    27.5262   1.355    0.175
## notgreennotred_break          34.0607    27.8270   1.224    0.221
## noobserved_break              23.1763    27.0705   0.856    0.392
## concentrationlab                  NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 254.12  on 224  degrees of freedom
## AIC: 314.12
##
## Number of Fisher Scoring iterations: 5
```

```
german_coeffs = coef(german_model)
boxplot(
  german_coeffs,
  xlab='german model',
  ylim=c(-20, 50), ylab='coefficient value', col='#0C1618'
)
abline(h=german_coeffs['german'])
```



Field

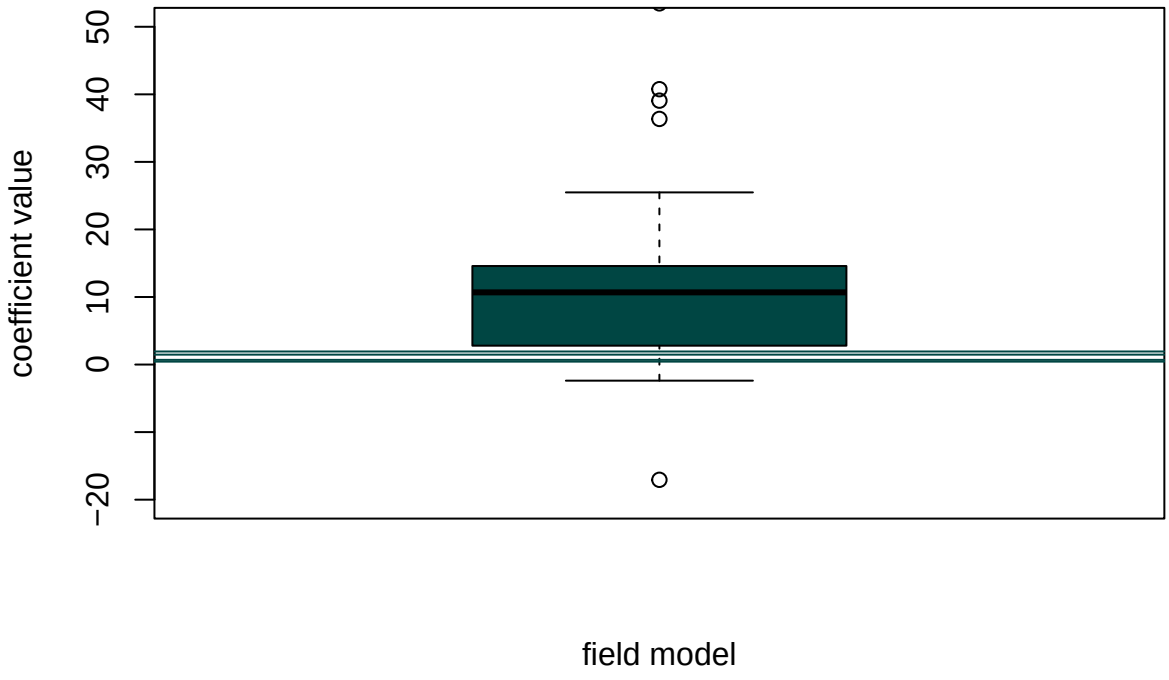
```
field_model <- glm(
      formula = binconcepts ~
                chemistry + textiles + biology + fast + pharma +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(field_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ chemistry + textiles + biology +
##     fast + pharma + greengreen_other + greenred_other + notgreennotred_other +
##     noobserved_other + greengreen_concentration + greenred_concentration +
```

```
##     notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0432  -0.7580  -0.2953   0.8211   2.0599
##
## Coefficients: (2 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -17.0601    27.8046  -0.614   0.5395
## chemistry                      1.9342     1.1616   1.665   0.0959 .
## textiles                       1.4673     1.1939   1.229   0.2191
## biology                        0.4329     1.3165   0.329   0.7423
## fast                           0.6963     1.7017   0.409   0.6824
## pharma                             NA         NA      NA       NA
## greengreen_other              11.1686    34.4986   0.324   0.7461
## greenred_other                10.6875    29.6222   0.361   0.7183
## notgreennotred_other          -0.9088    29.1721  -0.031   0.9751
## noobserved_other               0.5732    27.9898   0.020   0.9837
## greengreen_concentration      12.7995    27.8290   0.460   0.6456
## greenred_concentration         9.0277    27.5160   0.328   0.7428
## notgreennotred_concentration   5.4485    27.6159   0.197   0.8436
## noobserved_concentration      10.7623    27.7360   0.388   0.6980
## greengreen_width               4.6598    32.5489   0.143   0.8862
## greenred_width                 2.7952    27.1001   0.103   0.9178
## notgreennotred_width          14.5871    28.3430   0.515   0.6068
## noobserved_width               7.1577    27.6216   0.259   0.7955
## greengreen_wavelength         23.2797    34.1446   0.682   0.4954
## greenred_wavelength           14.5462    27.8003   0.523   0.6008
## notgreennotred_wavelength      5.2106    27.9102   0.187   0.8519
## noobserved_wavelength         14.1176    27.5660   0.512   0.6086
## greengreen_solution           53.4625    42.4479   1.259   0.2079
## greenred_solution             11.3517    27.6037   0.411   0.6809
## notgreennotred_solution       -2.3838    28.4829  -0.084   0.9333
## noobserved_solution           14.2962    27.8022   0.514   0.6071
## greengreen_pdf                18.8751    33.4865   0.564   0.5730
## greenred_pdf                   3.4941    28.0352   0.125   0.9008
## notgreennotred_pdf            21.6780    29.1523   0.744   0.4571
## noobserved_pdf                 7.5127    28.4154   0.264   0.7915
## greengreen_break              39.0663    36.7958   1.062   0.2884
## greenred_break                40.7588    30.8613   1.321   0.1866
## notgreennotred_break          36.3598    31.1582   1.167   0.2432
## noobserved_break              25.4843    30.3836   0.839   0.4016
## concentrationlab                   NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
```

```
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 245.57  on 221  degrees of freedom
## AIC: 311.57
##
## Number of Fisher Scoring iterations: 5
```

```
field_coeffs = coef(field_model)
boxplot(
  field_coeffs,
  xlab='field model',
  ylim=c(-20, 50), ylab='coefficient value', col='#004643'
)
abline(h=field_coeffs['chemistry'], col='#004643')
abline(h=field_coeffs['textiles'], col='#004643')
abline(h=field_coeffs['biology'], col='#004643')
abline(h=field_coeffs['fast'], col='#004643')
abline(h=field_coeffs['pharma'], col='#004643')
```



Year

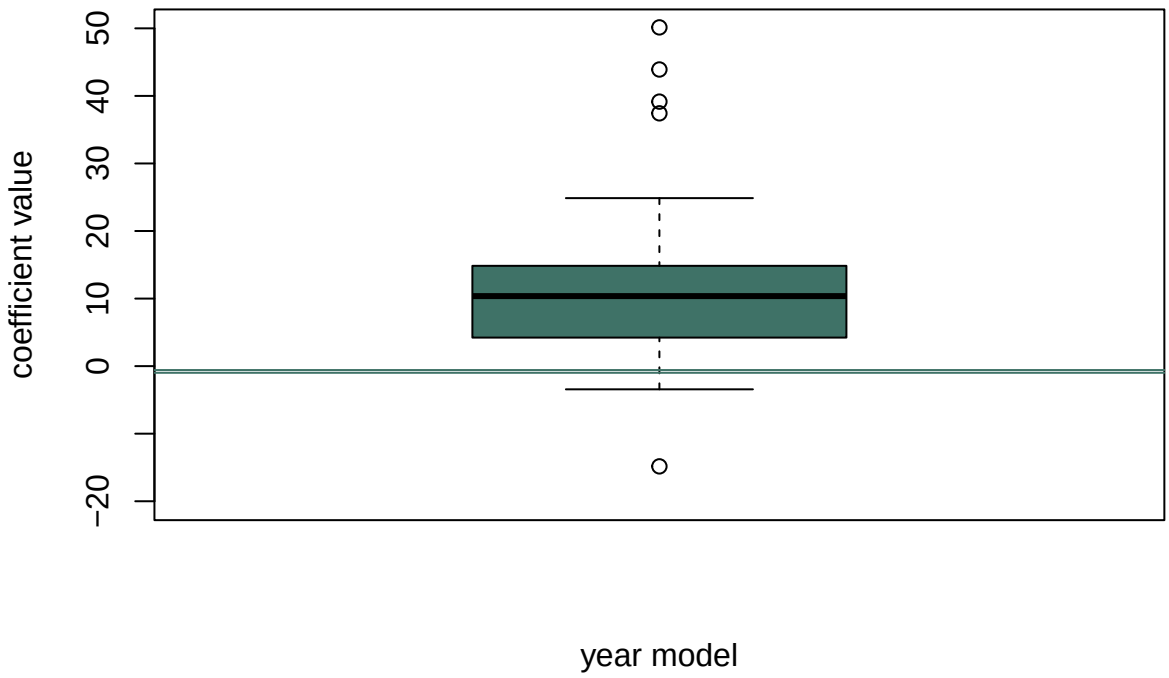
```
year_model <- glm(
      formula = binconcepts ~
```

```
                firsty + secondy + thirdy +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wav
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(year_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ firsty + secondy + thirdy + greengreen_other +
##     greenred_other + notgreennotred_other + noobserved_other +
##     greengreen_concentration + greenred_concentration + notgreennotred_concentration +
##     noobserved_concentration + greengreen_width + greenred_width +
##     notgreennotred_width + noobserved_width + greengreen_wavelength +
##     greenred_wavelength + notgreennotred_wavelength + noobserved_wavelength +
##     greengreen_solution + greenred_solution + notgreennotred_solution +
##     noobserved_solution + greengreen_pdf + greenred_pdf + notgreennotred_pdf +
##     noobserved_pdf + greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.2871  -0.7927  -0.3223   0.8013   2.1769
##
## Coefficients: (2 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -14.83727   28.07729  -0.528   0.5972
## firsty                        -0.98788    0.45088  -2.191   0.0285 *
## secondy                       -0.57904    0.45621  -1.269   0.2044
## thirdy                              NA         NA      NA       NA
## greengreen_other              11.06189   34.74701   0.318   0.7502
## greenred_other                11.51849   29.91647   0.385   0.7002
## notgreennotred_other          -0.30876   29.35993  -0.011   0.9916
## noobserved_other               0.08799   28.29613   0.003   0.9975
## greengreen_concentration      10.36530   28.11323   0.369   0.7124
## greenred_concentration         9.97580   27.88418   0.358   0.7205
## notgreennotred_concentration   5.31879   27.98584   0.190   0.8493
## noobserved_concentration      11.07717   28.11996   0.394   0.6936
## greengreen_width              -3.43449   32.83601  -0.105   0.9167
## greenred_width                 3.17202   27.44220   0.116   0.9080
## notgreennotred_width          12.58441   28.60266   0.440   0.6600
## noobserved_width               7.61086   28.04172   0.271   0.7861
## greengreen_wavelength         24.86815   34.69395   0.717   0.4735
## greenred_wavelength           12.32470   28.12443   0.438   0.6612
## notgreennotred_wavelength      7.59359   28.28912   0.268   0.7884
## noobserved_wavelength         14.41963   27.97109   0.516   0.6062
```

```
## greengreen_solution           43.91221   42.17690   1.041   0.2978
## greenred_solution              9.75157   27.91558   0.349   0.7268
## notgreennotred_solution       -1.29214   28.75588  -0.045   0.9642
## noobserved_solution           13.38018   28.16053   0.475   0.6347
## greengreen_pdf                15.27489   33.35104   0.458   0.6469
## greenred_pdf                   5.27195   28.43387   0.185   0.8529
## notgreennotred_pdf            18.24847   29.29037   0.623   0.5333
## noobserved_pdf                 8.80063   28.75952   0.306   0.7596
## greengreen_break              50.14350   37.33945   1.343   0.1793
## greenred_break                39.15347   31.05363   1.261   0.2074
## notgreennotred_break          37.42130   31.32038   1.195   0.2322
## noobserved_break              24.79551   30.56728   0.811   0.4173
## concentrationlab                    NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 250.45  on 223  degrees of freedom
## AIC: 312.45
##
## Number of Fisher Scoring iterations: 5
```

```
year_coeffs = coef(year_model)
boxplot(
  year_coeffs,
  xlab='year model',
  ylim=c(-20, 50), ylab='coefficient value', col='#3F7267'
)
abline(h=year_coeffs['firsty'], col='#3F7267')
abline(h=year_coeffs['secondy'], col='#3F7267')
abline(h=year_coeffs['thirdy'], col='#3F7267')
```



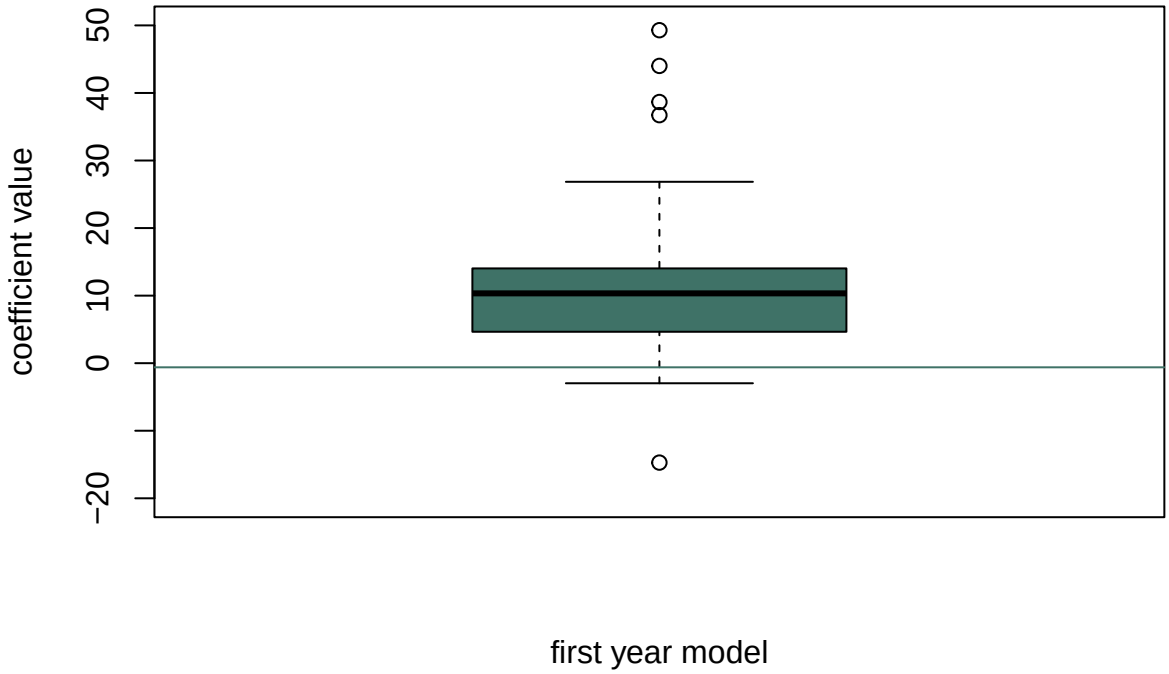
First Year

```
firsty_model <- glm(
      formula = binconcepts ~
                firsty +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(firsty_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ firsty + greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
```

```
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.1694  -0.7980  -0.3475   0.8111   2.1088
##
## Coefficients: (1 not defined because of singularities)
##                              Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 -14.7143    25.1301  -0.586   0.5582
## firsty                       -0.6105     0.3360  -1.817   0.0692 .
## greengreen_other             11.0344    32.6007   0.338   0.7350
## greenred_other               11.4132    26.7993   0.426   0.6702
## notgreennotred_other         -0.4062    26.5937  -0.015   0.9878
## noobserved_other             -0.3425    25.3971  -0.013   0.9892
## greengreen_concentration      9.9138    25.2594   0.392   0.6947
## greenred_concentration        9.3285    24.9493   0.374   0.7085
## notgreennotred_concentration  4.6510    25.0662   0.186   0.8528
## noobserved_concentration     10.5616    25.1774   0.419   0.6749
## greengreen_width             -2.9711    30.3783  -0.098   0.9221
## greenred_width                2.3479    24.5965   0.095   0.9240
## notgreennotred_width         12.7739    25.7129   0.497   0.6193
## noobserved_width              6.4668    25.0968   0.258   0.7967
## greengreen_wavelength        26.8514    32.3478   0.830   0.4065
## greenred_wavelength          11.1821    25.2282   0.443   0.6576
## notgreennotred_wavelength     7.2831    25.4128   0.287   0.7744
## noobserved_wavelength        14.0282    25.0367   0.560   0.5753
## greengreen_solution          44.0065    40.5766   1.085   0.2781
## greenred_solution            10.1043    25.0352   0.404   0.6865
## notgreennotred_solution      -2.3601    25.9747  -0.091   0.9276
## noobserved_solution          11.9493    25.1802   0.475   0.6351
## greengreen_pdf               12.8627    31.0415   0.414   0.6786
## greenred_pdf                  5.0500    25.5277   0.198   0.8432
## notgreennotred_pdf           16.7134    26.5322   0.630   0.5287
## noobserved_pdf                7.8626    25.8895   0.304   0.7614
## greengreen_break             49.2901    35.0361   1.407   0.1595
## greenred_break               38.6604    28.2724   1.367   0.1715
## notgreennotred_break         36.7134    28.6414   1.282   0.1999
## noobserved_break             24.9162    27.8242   0.895   0.3705
## concentrationlab                  NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 252.07  on 224  degrees of freedom
## AIC: 312.07
##
## Number of Fisher Scoring iterations: 5
```

```
firsty_coeffs = coef(firsty_model)
boxplot(
  firsty_coeffs,
  xlab='first year model',
  ylim=c(-20, 50), ylab='coefficient value', col='#3F7267'
)
abline(h=firsty_coeffs['firsty'], col='#3F7267')
```



Second Year

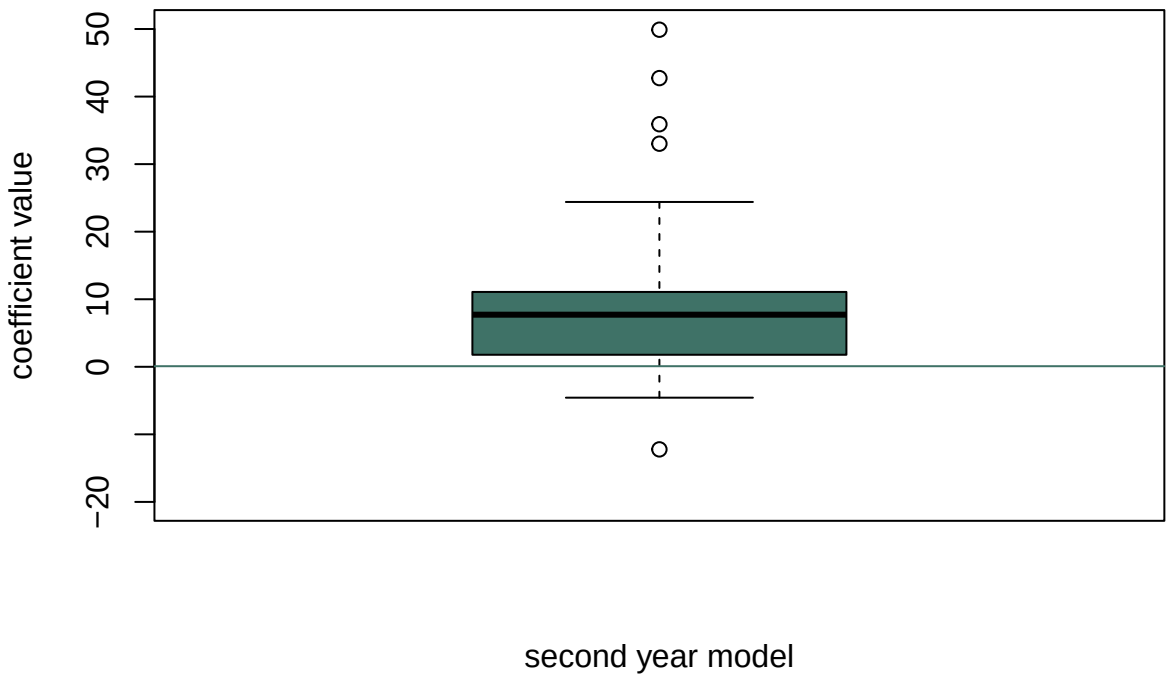
```
secondy_model <- glm(
      formula = binconcepts ~
                secondy +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wav
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
```

```
    )
summary(secondy_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ secondy + greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0966  -0.7662  -0.3356   0.8508   2.1713
##
## Coefficients: (1 not defined because of singularities)
##                              Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 -12.2245    22.7830  -0.537    0.592
## secondy                       0.0877     0.3375   0.260    0.795
## greengreen_other              9.4302    31.1738   0.303    0.762
## greenred_other                8.2461    24.3355   0.339    0.735
## notgreennotred_other         -3.7729    24.4831  -0.154    0.878
## noobserved_other             -2.4074    23.0822  -0.104    0.917
## greengreen_concentration      7.7887    23.0383   0.338    0.735
## greenred_concentration        6.6109    22.6314   0.292    0.770
## notgreennotred_concentration  1.7797    22.7536   0.078    0.938
## noobserved_concentration      7.6397    22.8433   0.334    0.738
## greengreen_width             -3.6800    28.4678  -0.129    0.897
## greenred_width               -0.2755    22.4038  -0.012    0.990
## notgreennotred_width         10.8370    23.4178   0.463    0.644
## noobserved_width              3.7862    22.7755   0.166    0.868
## greengreen_wavelength        24.3991    30.3907   0.803    0.422
## greenred_wavelength           9.2389    22.9664   0.402    0.687
## notgreennotred_wavelength     4.0491    23.1356   0.175    0.861
## noobserved_wavelength        11.0798    22.6861   0.488    0.625
## greengreen_solution          49.8984    39.1960   1.273    0.203
## greenred_solution             7.3181    22.8034   0.321    0.748
## notgreennotred_solution      -4.5699    23.7643  -0.192    0.848
## noobserved_solution           9.3769    22.8336   0.411    0.681
## greengreen_pdf                9.6442    29.0097   0.332    0.740
## greenred_pdf                  2.1435    23.2500   0.092    0.927
## notgreennotred_pdf           15.5914    24.4340   0.638    0.523
## noobserved_pdf                4.8389    23.6423   0.205    0.838
## greengreen_break             42.7352    32.6394   1.309    0.190
## greenred_break               35.9061    25.8178   1.391    0.164
## notgreennotred_break         33.0236    26.2748   1.257    0.209
## noobserved_break             22.1956    25.4441   0.872    0.383
## concentrationlab                  NA         NA      NA       NA
```

```
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 255.37  on 224  degrees of freedom
## AIC: 315.37
##
## Number of Fisher Scoring iterations: 5
```

```
secondy_coeffs = coef(secondy_model)
boxplot(
  secondy_coeffs,
  xlab='second year model',
  ylim=c(-20, 50), ylab='coefficient value', col='#3F7267'
)
abline(h=secondy_coeffs['secondy'], col='#3F7267')
```



Third Year

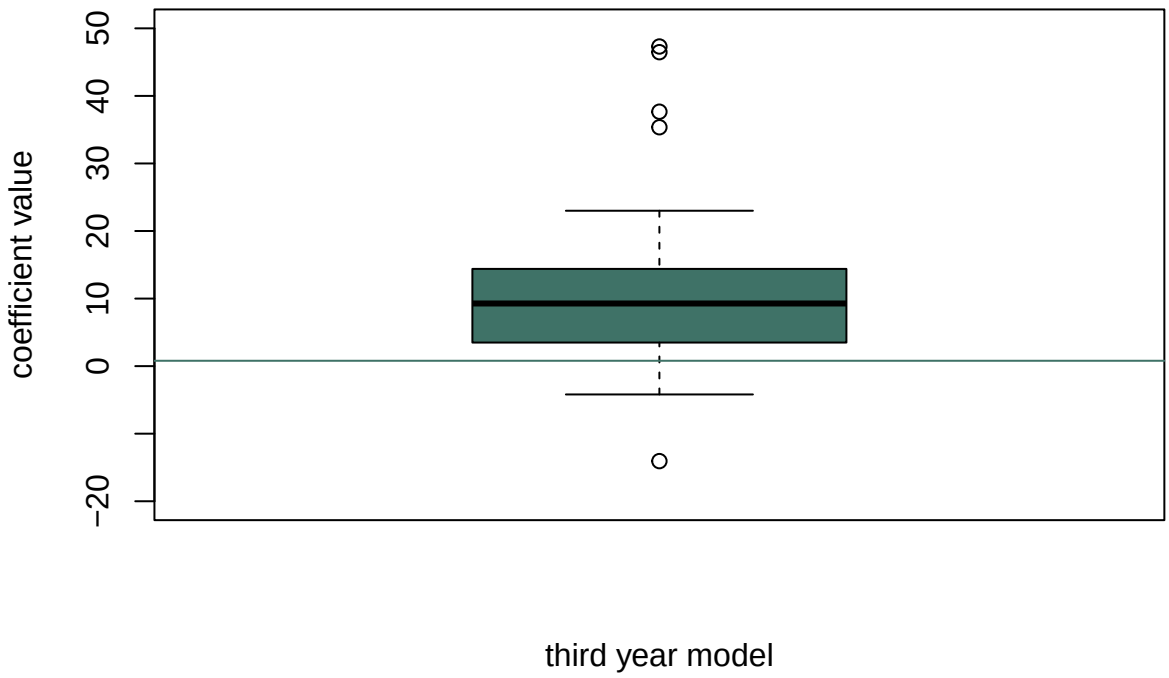
```
thirdy_model <- glm(
      formula = binconcepts ~
                thirdy +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
```

```
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(thirdy_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ thirdy + greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.2744  -0.7697  -0.3272   0.8284   2.2473
##
## Coefficients: (1 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -14.0593    27.7555  -0.507   0.6125
## thirdy                         0.7946     0.4133   1.923   0.0545 .
## greengreen_other               9.9880    34.6355   0.288   0.7731
## greenred_other                 9.4720    29.5568   0.320   0.7486
## notgreennotred_other          -2.4102    29.0779  -0.083   0.9339
## noobserved_other              -1.0976    27.9668  -0.039   0.9687
## greengreen_concentration       9.1154    27.8103   0.328   0.7431
## greenred_concentration         8.4918    27.5669   0.308   0.7580
## notgreennotred_concentration   3.7748    27.6623   0.136   0.8915
## noobserved_concentration       9.4257    27.7882   0.339   0.7345
## greengreen_width              -4.1923    32.5666  -0.129   0.8976
## greenred_width                 1.7980    27.1609   0.066   0.9472
## notgreennotred_width          11.2513    28.2648   0.398   0.6906
## noobserved_width               6.3833    27.7385   0.230   0.8180
## greengreen_wavelength         22.2531    34.2089   0.651   0.5154
## greenred_wavelength           11.5790    27.8311   0.416   0.6774
## notgreennotred_wavelength      5.6431    27.9456   0.202   0.8400
## noobserved_wavelength         12.6815    27.6213   0.459   0.6461
## greengreen_solution           47.3135    41.8085   1.132   0.2578
## greenred_solution              7.7539    27.5828   0.281   0.7786
## notgreennotred_solution       -2.2869    28.4496  -0.080   0.9359
## noobserved_solution           12.3361    27.8496   0.443   0.6578
```

```
## greengreen_pdf                14.3940    32.9597   0.437   0.6623
## greenred_pdf                   3.4901    28.1114   0.124   0.9012
## notgreennotred_pdf            18.2401    29.0116   0.629   0.5295
## noobserved_pdf                 7.2460    28.4556   0.255   0.7990
## greengreen_break              46.4728    36.6943   1.266   0.2053
## greenred_break                37.6629    30.5918   1.231   0.2183
## notgreennotred_break          35.3587    30.8519   1.146   0.2518
## noobserved_break              23.0011    30.1161   0.764   0.4450
## concentrationlab                   NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 251.66  on 224  degrees of freedom
## AIC: 311.66
##
## Number of Fisher Scoring iterations: 5
```

```
thirdy_coeffs = coef(thirdy_model)
boxplot(
  thirdy_coeffs,
  xlab='third year model',
  ylim=c(-20, 50), ylab='coefficient value', col='#3F7267'
)
abline(h=thirdy_coeffs['thirdy'], col='#3F7267')
```



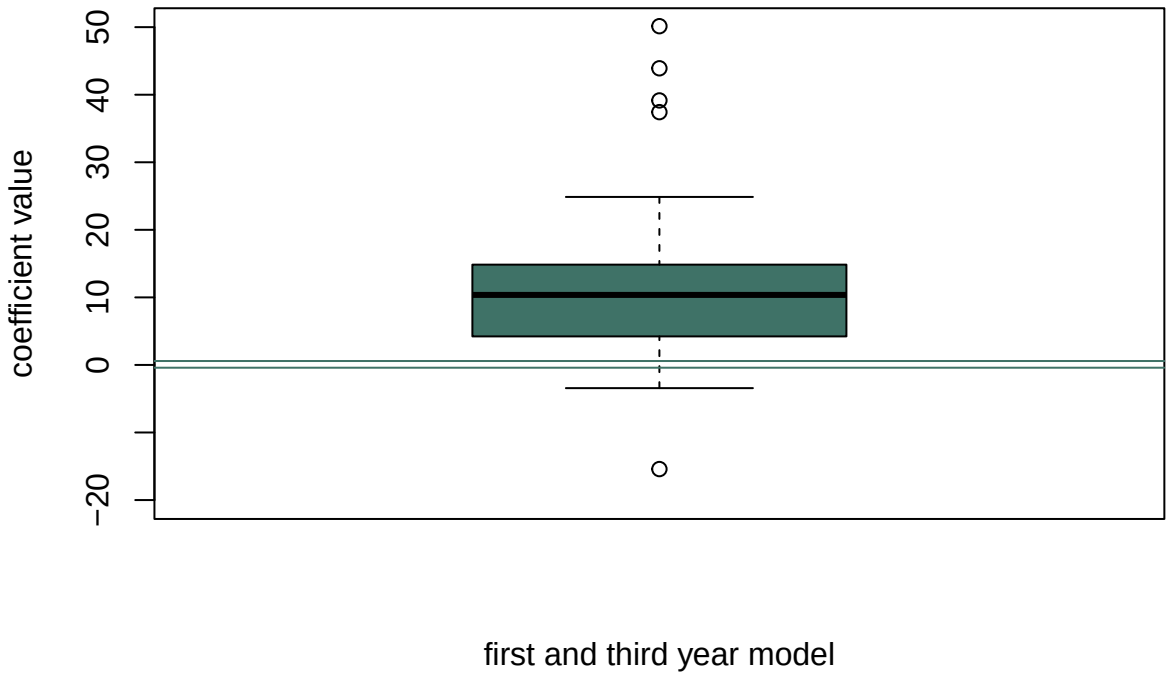
First Year and Third Year

```
firstthree_model <- glm(
      formula = binconcepts ~
                firsty + thirdy +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(firstthree_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ firsty + thirdy + greengreen_other +
##     greenred_other + notgreennotred_other + noobserved_other +
##     greengreen_concentration + greenred_concentration + notgreennotred_concentration +
##     noobserved_concentration + greengreen_width + greenred_width +
```

```
##     notgreennotred_width + noobserved_width + greengreen_wavelength +
##     greenred_wavelength + notgreennotred_wavelength + noobserved_wavelength +
##     greengreen_solution + greenred_solution + notgreennotred_solution +
##     noobserved_solution + greengreen_pdf + greenred_pdf + notgreennotred_pdf +
##     noobserved_pdf + greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.2871  -0.7927  -0.3223   0.8013   2.1769
##
## Coefficients: (1 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -15.41631   28.08550  -0.549    0.583
## firsty                        -0.40884    0.37140  -1.101    0.271
## thirdy                         0.57904    0.45621   1.269    0.204
## greengreen_other              11.06189   34.74701   0.318    0.750
## greenred_other                11.51849   29.91647   0.385    0.700
## notgreennotred_other          -0.30876   29.35993  -0.011    0.992
## noobserved_other               0.08799   28.29613   0.003    0.998
## greengreen_concentration      10.36530   28.11323   0.369    0.712
## greenred_concentration         9.97580   27.88418   0.358    0.721
## notgreennotred_concentration   5.31879   27.98584   0.190    0.849
## noobserved_concentration      11.07717   28.11996   0.394    0.694
## greengreen_width              -3.43449   32.83601  -0.105    0.917
## greenred_width                 3.17202   27.44220   0.116    0.908
## notgreennotred_width          12.58441   28.60266   0.440    0.660
## noobserved_width               7.61086   28.04172   0.271    0.786
## greengreen_wavelength         24.86815   34.69395   0.717    0.474
## greenred_wavelength           12.32470   28.12443   0.438    0.661
## notgreennotred_wavelength      7.59359   28.28912   0.268    0.788
## noobserved_wavelength         14.41963   27.97109   0.516    0.606
## greengreen_solution           43.91221   42.17690   1.041    0.298
## greenred_solution              9.75157   27.91558   0.349    0.727
## notgreennotred_solution       -1.29214   28.75588  -0.045    0.964
## noobserved_solution           13.38018   28.16053   0.475    0.635
## greengreen_pdf                15.27489   33.35104   0.458    0.647
## greenred_pdf                   5.27195   28.43387   0.185    0.853
## notgreennotred_pdf            18.24847   29.29037   0.623    0.533
## noobserved_pdf                 8.80063   28.75952   0.306    0.760
## greengreen_break              50.14350   37.33945   1.343    0.179
## greenred_break                39.15347   31.05363   1.261    0.207
## notgreennotred_break          37.42130   31.32038   1.195    0.232
## noobserved_break              24.79551   30.56728   0.811    0.417
## concentrationlab                    NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 250.45  on 223  degrees of freedom
## AIC: 312.45
##
## Number of Fisher Scoring iterations: 5
```

```
firstthree_coeffs = coef(firstthree_model)
boxplot(
  firstthree_coeffs,
  xlab='first and third year model',
  ylim=c(-20, 50), ylab='coefficient value', col='#3F7267'
)
abline(h=firstthree_coeffs['firsty'], col='#3F7267')
abline(h=firstthree_coeffs['thirdy'], col='#3F7267')
```



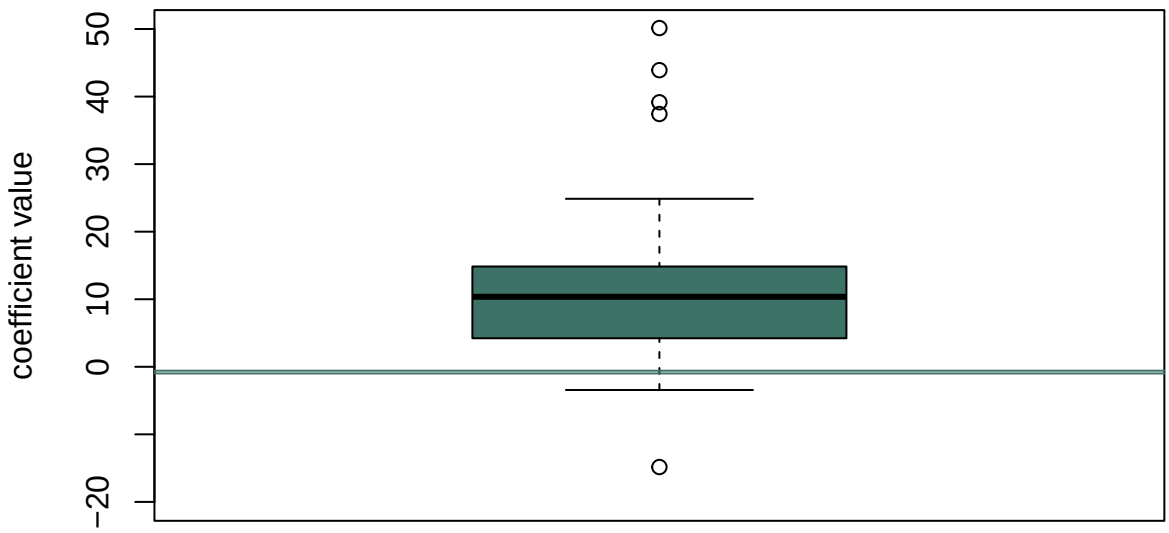
First and Second

```
firstsecond_model <- glm(
      formula = binconcepts ~
                firsty + secondy +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(firstsecond_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ firsty + secondy + greengreen_other +
##     greenred_other + notgreennotred_other + noobserved_other +
##     greengreen_concentration + greenred_concentration + notgreennotred_concentration +
##     noobserved_concentration + greengreen_width + greenred_width +
##     notgreennotred_width + noobserved_width + greengreen_wavelength +
##     greenred_wavelength + notgreennotred_wavelength + noobserved_wavelength +
##     greengreen_solution + greenred_solution + notgreennotred_solution +
##     noobserved_solution + greengreen_pdf + greenred_pdf + notgreennotred_pdf +
##     noobserved_pdf + greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.2871  -0.7927  -0.3223   0.8013   2.1769
##
## Coefficients: (1 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -14.83727   28.07729  -0.528   0.5972
## firsty                        -0.98788    0.45088  -2.191   0.0285 *
## secondy                       -0.57904    0.45621  -1.269   0.2044
## greengreen_other              11.06189   34.74701   0.318   0.7502
## greenred_other                11.51849   29.91647   0.385   0.7002
## notgreennotred_other          -0.30876   29.35993  -0.011   0.9916
## noobserved_other               0.08799   28.29613   0.003   0.9975
## greengreen_concentration      10.36530   28.11323   0.369   0.7124
## greenred_concentration         9.97580   27.88418   0.358   0.7205
## notgreennotred_concentration   5.31879   27.98584   0.190   0.8493
## noobserved_concentration      11.07717   28.11996   0.394   0.6936
## greengreen_width              -3.43449   32.83601  -0.105   0.9167
## greenred_width                 3.17202   27.44220   0.116   0.9080
## notgreennotred_width          12.58441   28.60266   0.440   0.6600
## noobserved_width               7.61086   28.04172   0.271   0.7861
## greengreen_wavelength         24.86815   34.69395   0.717   0.4735
## greenred_wavelength           12.32470   28.12443   0.438   0.6612
## notgreennotred_wavelength      7.59359   28.28912   0.268   0.7884
## noobserved_wavelength         14.41963   27.97109   0.516   0.6062
## greengreen_solution           43.91221   42.17690   1.041   0.2978
## greenred_solution              9.75157   27.91558   0.349   0.7268
## notgreennotred_solution       -1.29214   28.75588  -0.045   0.9642
## noobserved_solution           13.38018   28.16053   0.475   0.6347
## greengreen_pdf                15.27489   33.35104   0.458   0.6469
## greenred_pdf                   5.27195   28.43387   0.185   0.8529
## notgreennotred_pdf            18.24847   29.29037   0.623   0.5333
## noobserved_pdf                 8.80063   28.75952   0.306   0.7596
## greengreen_break              50.14350   37.33945   1.343   0.1793
## greenred_break                39.15347   31.05363   1.261   0.2074
## notgreennotred_break          37.42130   31.32038   1.195   0.2322
## noobserved_break              24.79551   30.56728   0.811   0.4173
## concentrationlab                   NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 250.45  on 223  degrees of freedom
## AIC: 312.45
##
## Number of Fisher Scoring iterations: 5
```

```
firstsecond_coeffs = coef(firstsecond_model)
boxplot(
  firstsecond_coeffs,
  xlab='first and second year model',
  ylim=c(-20, 50), ylab='coefficient value', col='#3F7267'
)
abline(h=firstsecond_coeffs['firsty'], col='#3F7267')
abline(h=firstsecond_coeffs['secondy'], col='#3F7267')
```



Second and third year

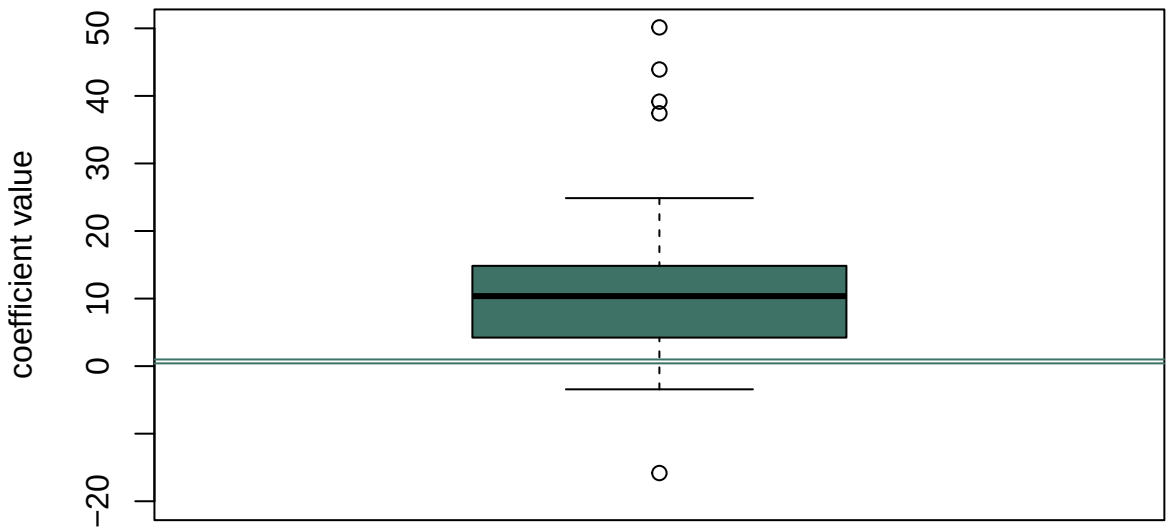
```
secondthird_model <- glm(
      formula = binconcepts ~
                secondy + thirdy +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
```

```
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(secondthird_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ secondy + thirdy + greengreen_other +
##     greenred_other + notgreennotred_other + noobserved_other +
##     greengreen_concentration + greenred_concentration + notgreennotred_concentration +
##     noobserved_concentration + greengreen_width + greenred_width +
##     notgreennotred_width + noobserved_width + greengreen_wavelength +
##     greenred_wavelength + notgreennotred_wavelength + noobserved_wavelength +
##     greengreen_solution + greenred_solution + notgreennotred_solution +
##     noobserved_solution + greengreen_pdf + greenred_pdf + notgreennotred_pdf +
##     noobserved_pdf + greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.2871  -0.7927  -0.3223   0.8013   2.1769
##
## Coefficients: (1 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -15.82515   28.10447  -0.563   0.5734
## secondy                        0.40884    0.37140   1.101   0.2710
## thirdy                         0.98788    0.45088   2.191   0.0285 *
## greengreen_other              11.06189   34.74701   0.318   0.7502
## greenred_other                11.51849   29.91647   0.385   0.7002
## notgreennotred_other          -0.30876   29.35993  -0.011   0.9916
## noobserved_other               0.08799   28.29613   0.003   0.9975
## greengreen_concentration      10.36530   28.11323   0.369   0.7124
## greenred_concentration         9.97580   27.88418   0.358   0.7205
## notgreennotred_concentration   5.31879   27.98584   0.190   0.8493
## noobserved_concentration      11.07717   28.11996   0.394   0.6936
## greengreen_width              -3.43449   32.83601  -0.105   0.9167
## greenred_width                 3.17202   27.44220   0.116   0.9080
## notgreennotred_width          12.58441   28.60266   0.440   0.6600
## noobserved_width               7.61086   28.04172   0.271   0.7861
## greengreen_wavelength         24.86815   34.69395   0.717   0.4735
## greenred_wavelength           12.32470   28.12443   0.438   0.6612
## notgreennotred_wavelength      7.59359   28.28912   0.268   0.7884
## noobserved_wavelength         14.41963   27.97109   0.516   0.6062
## greengreen_solution           43.91221   42.17690   1.041   0.2978
## greenred_solution              9.75157   27.91558   0.349   0.7268
## notgreennotred_solution       -1.29214   28.75588  -0.045   0.9642
```

```
## noobserved_solution           13.38018   28.16053   0.475   0.6347
## greengreen_pdf                15.27489   33.35104   0.458   0.6469
## greenred_pdf                   5.27195   28.43387   0.185   0.8529
## notgreennotred_pdf            18.24847   29.29037   0.623   0.5333
## noobserved_pdf                 8.80063   28.75952   0.306   0.7596
## greengreen_break              50.14350   37.33945   1.343   0.1793
## greenred_break                39.15347   31.05363   1.261   0.2074
## notgreennotred_break          37.42130   31.32038   1.195   0.2322
## noobserved_break              24.79551   30.56728   0.811   0.4173
## concentrationlab                    NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 250.45  on 223  degrees of freedom
## AIC: 312.45
##
## Number of Fisher Scoring iterations: 5
```

```
secondthird_coeffs = coef(secondthird_model)
boxplot(
  secondthird_coeffs,
  xlab='second and third year model',
  ylim=c(-20, 50), ylab='coefficient value', col='#3F7267'
)
abline(h=secondthird_coeffs['thirdy'], col='#3F7267')
abline(h=secondthird_coeffs['secondy'], col='#3F7267')
```



second and third year model

Gender

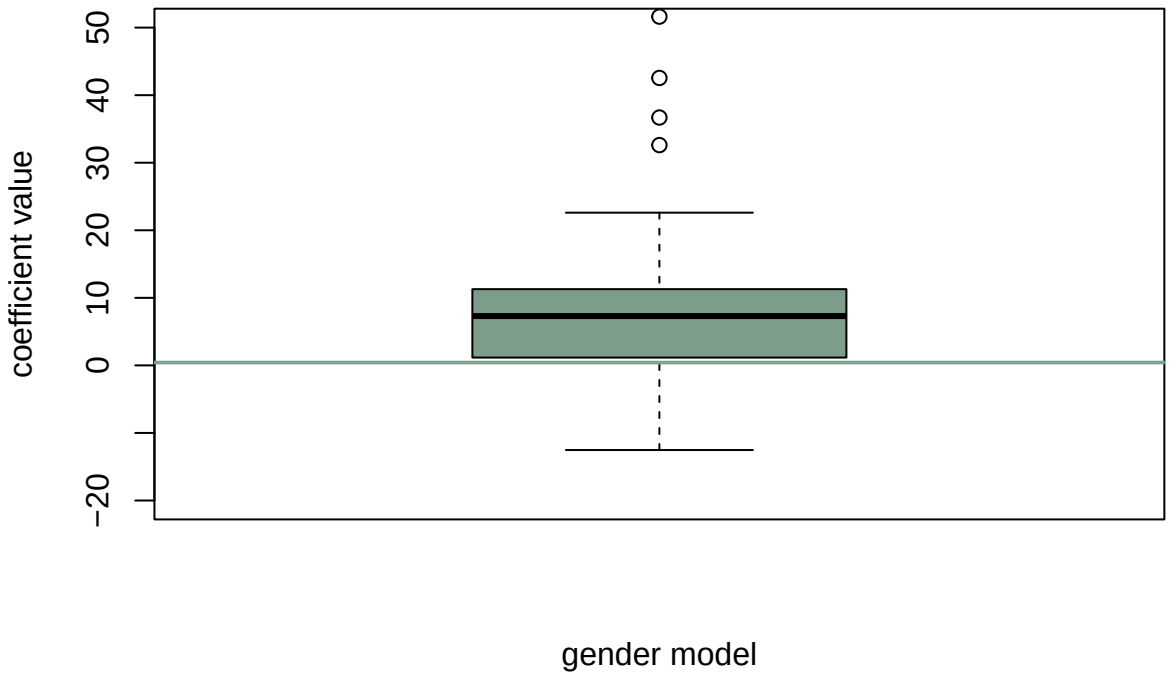
```
gender_model <- glm(
      formula = binconcepts ~
                male + female + other +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(gender_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ male + female + other + greengreen_other +
##     greenred_other + notgreennotred_other + noobserved_other +
##     greengreen_concentration + greenred_concentration + notgreennotred_concentration +
```

```
##     noobserved_concentration + greengreen_width + greenred_width +
##     notgreennotred_width + noobserved_width + greengreen_wavelength +
##     greenred_wavelength + notgreennotred_wavelength + noobserved_wavelength +
##     greengreen_solution + greenred_solution + notgreennotred_solution +
##     noobserved_solution + greengreen_pdf + greenred_pdf + notgreennotred_pdf +
##     noobserved_pdf + greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0939  -0.7620  -0.3316   0.8611   2.2256
##
## Coefficients: (2 not defined because of singularities)
##                              Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -12.5286    22.3990  -0.559    0.576
## male                           0.3018     0.8834   0.342    0.733
## female                         0.5397     0.8869   0.608    0.543
## other                              NA         NA      NA       NA
## greengreen_other               7.6878    31.1118   0.247    0.805
## greenred_other                 8.1363    23.8965   0.340    0.733
## notgreennotred_other          -3.2953    24.1834  -0.136    0.892
## noobserved_other              -2.8622    22.6998  -0.126    0.900
## greengreen_concentration       7.4660    22.6716   0.329    0.742
## greenred_concentration         6.2322    22.2478   0.280    0.779
## notgreennotred_concentration   1.7757    22.3735   0.079    0.937
## noobserved_concentration       7.3028    22.4538   0.325    0.745
## greengreen_width              -4.4553    28.0809  -0.159    0.874
## greenred_width                -0.7740    22.0557  -0.035    0.972
## notgreennotred_width          10.6387    23.0373   0.462    0.644
## noobserved_width               3.9919    22.4329   0.178    0.859
## greengreen_wavelength         22.6048    29.9633   0.754    0.451
## greenred_wavelength            9.7400    22.6467   0.430    0.667
## notgreennotred_wavelength      3.9196    22.7514   0.172    0.863
## noobserved_wavelength         11.1972    22.2855   0.502    0.615
## greengreen_solution           51.6288    39.0129   1.323    0.186
## greenred_solution              6.3970    22.4024   0.286    0.775
## notgreennotred_solution       -3.9609    23.4889  -0.169    0.866
## noobserved_solution            9.2887    22.4728   0.413    0.679
## greengreen_pdf                11.3713    28.9211   0.393    0.694
## greenred_pdf                   1.8405    22.8493   0.081    0.936
## notgreennotred_pdf            15.4269    24.1138   0.640    0.522
## noobserved_pdf                 4.6290    23.2618   0.199    0.842
## greengreen_break              42.5479    32.4144   1.313    0.189
## greenred_break                36.6913    25.4776   1.440    0.150
## notgreennotred_break          32.6107    25.9171   1.258    0.208
## noobserved_break              22.4042    25.0794   0.893    0.372
## concentrationlab                   NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 254.72  on 223  degrees of freedom
## AIC: 316.72
##
```

```
## Number of Fisher Scoring iterations: 5
```

```
gender_coeffs = coef(gender_model)
boxplot(
  gender_coeffs,
  xlab='gender model',
  ylim=c(-20, 50), ylab='coefficient value', col='#7D9D8B'
)
abline(h=gender_coeffs['male'], col='#7D9D8B')
abline(h=gender_coeffs['female'], col='#7D9D8B')
abline(h=gender_coeffs['other'], col='#7D9D8B')
```



Female

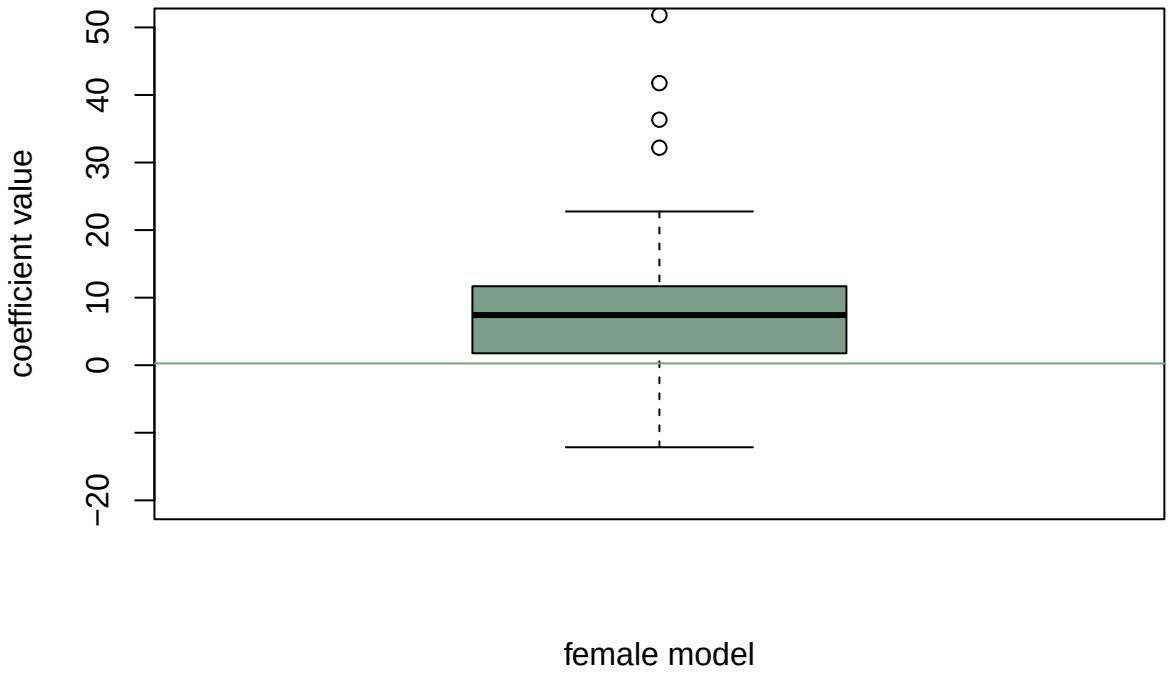
```
female_model <- glm(
      formula = binconcepts ~
                female +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
```

```
      family=binomial
    )
summary(female_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ female + greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.1063  -0.7606  -0.3296   0.8680   2.2232
##
## Coefficients: (1 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -12.1465    22.1842  -0.548    0.584
## female                         0.2598     0.3349   0.776    0.438
## greengreen_other               8.0156    30.9603   0.259    0.796
## greenred_other                 7.9868    23.7039   0.337    0.736
## notgreennotred_other          -3.7685    24.0053  -0.157    0.875
## noobserved_other              -2.9326    22.5248  -0.130    0.896
## greengreen_concentration       7.5414    22.4910   0.335    0.737
## greenred_concentration         6.2569    22.0632   0.284    0.777
## notgreennotred_concentration   1.7647    22.1884   0.080    0.937
## noobserved_concentration       7.2994    22.2660   0.328    0.743
## greengreen_width              -4.1496    27.9080  -0.149    0.882
## greenred_width                -0.7465    21.8809  -0.034    0.973
## notgreennotred_width          10.7644    22.8555   0.471    0.638
## noobserved_width               4.0951    22.2352   0.184    0.854
## greengreen_wavelength         22.7554    29.7993   0.764    0.445
## greenred_wavelength            9.3154    22.4225   0.415    0.678
## notgreennotred_wavelength      4.0922    22.5669   0.181    0.856
## noobserved_wavelength         10.9976    22.0937   0.498    0.619
## greengreen_solution           51.8183    38.8914   1.332    0.183
## greenred_solution              6.5271    22.2200   0.294    0.769
## notgreennotred_solution       -4.2432    23.2802  -0.182    0.855
## noobserved_solution            9.3981    22.2792   0.422    0.673
## greengreen_pdf                11.6870    28.7675   0.406    0.685
## greenred_pdf                   1.9325    22.6679   0.085    0.932
## notgreennotred_pdf            15.5975    23.9387   0.652    0.515
## noobserved_pdf                 4.6018    23.0903   0.199    0.842
## greengreen_break              41.7565    32.1667   1.298    0.194
## greenred_break                36.3405    25.2672   1.438    0.150
## notgreennotred_break          32.1936    25.7193   1.252    0.211
## noobserved_break              22.1193    24.8927   0.889    0.374
```

```
## concentrationlab                   NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 254.84  on 224  degrees of freedom
## AIC: 314.84
##
## Number of Fisher Scoring iterations: 5
```

```
female_coeffs = coef(female_model)
boxplot(
  female_coeffs,
  xlab='female model',
  ylim=c(-20, 50), ylab='coefficient value', col='#7D9D8B'
)
abline(h=female_coeffs['female'], col='#7D9D8B')
```



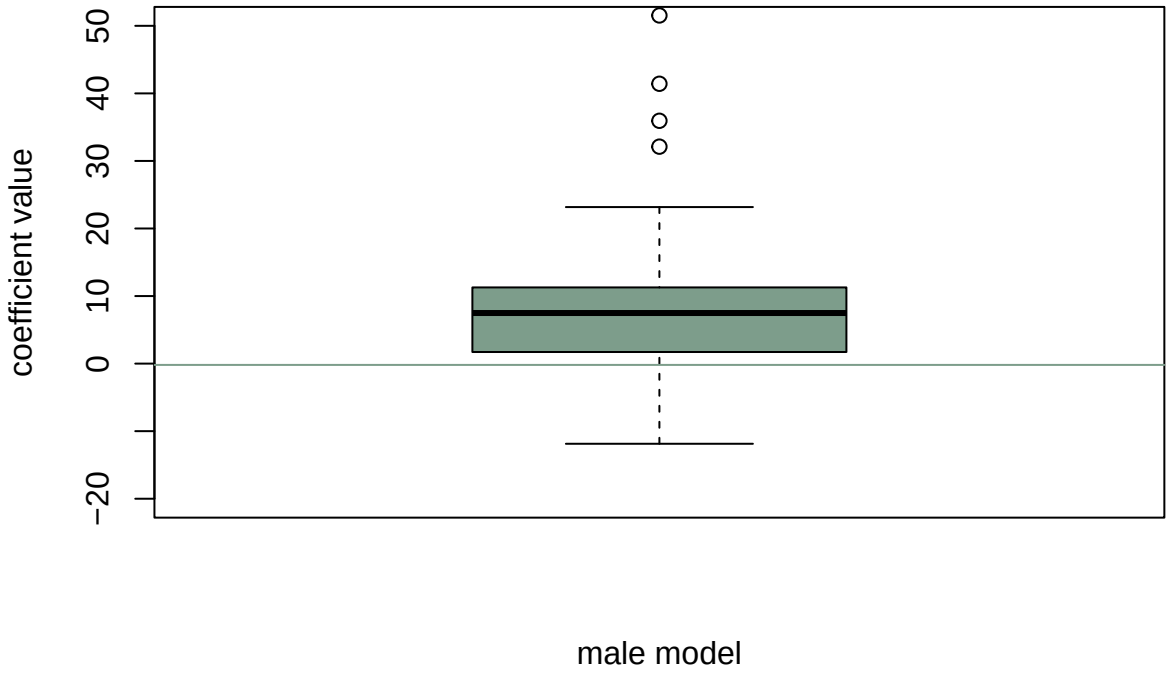

```
male_model <- glm(
      formula = binconcepts ~
                male +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wav
```

```
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(male_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ male + greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.1008  -0.7633  -0.3259   0.8558   2.2178
##
## Coefficients: (1 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -11.8673    22.3352  -0.531    0.595
## male                          -0.1941     0.3334  -0.582    0.560
## greengreen_other               8.6096    30.9851   0.278    0.781
## greenred_other                 7.8828    23.8636   0.330    0.741
## notgreennotred_other          -4.1602    24.1363  -0.172    0.863
## noobserved_other              -2.8462    22.6721  -0.126    0.900
## greengreen_concentration       7.6278    22.6278   0.337    0.736
## greenred_concentration         6.3396    22.2063   0.285    0.775
## notgreennotred_concentration   1.7172    22.3304   0.077    0.939
## noobserved_concentration       7.3517    22.4077   0.328    0.743
## greengreen_width              -3.8569    28.0435  -0.138    0.891
## greenred_width                -0.6085    22.0150  -0.028    0.978
## notgreennotred_width          10.8170    22.9978   0.470    0.638
## noobserved_width               4.0514    22.3712   0.181    0.856
## greengreen_wavelength         23.1699    29.8941   0.775    0.438
## greenred_wavelength            9.0343    22.5634   0.400    0.689
## notgreennotred_wavelength      4.1261    22.7118   0.182    0.856
## noobserved_wavelength         10.8308    22.2419   0.487    0.626
## greengreen_solution           51.5352    38.9553   1.323    0.186
## greenred_solution              6.7682    22.3542   0.303    0.762
## notgreennotred_solution       -4.5627    23.3845  -0.195    0.845
## noobserved_solution            9.4728    22.4197   0.423    0.673
## greengreen_pdf                11.2777    28.8560   0.391    0.696
## greenred_pdf                   1.9923    22.8147   0.087    0.930
## notgreennotred_pdf            15.7727    24.0639   0.655    0.512
```

```
## noobserved_pdf                 4.6205    23.2351   0.199    0.842
## greengreen_break              41.4243    32.2701   1.284    0.199
## greenred_break                35.9451    25.3881   1.416    0.157
## notgreennotred_break          32.1151    25.8658   1.242    0.214
## noobserved_break              21.8846    25.0227   0.875    0.382
## concentrationlab                   NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 255.10  on 224  degrees of freedom
## AIC: 315.1
##
## Number of Fisher Scoring iterations: 5
```

```
male_coeffs = coef(male_model)
boxplot(
  male_coeffs,
  xlab='male model',
  ylim=c(-20, 50), ylab='coefficient value', col='#7D9D8B'
)
abline(h=male_coeffs['male'], col='#7D9D8B')
```



Double Demographics

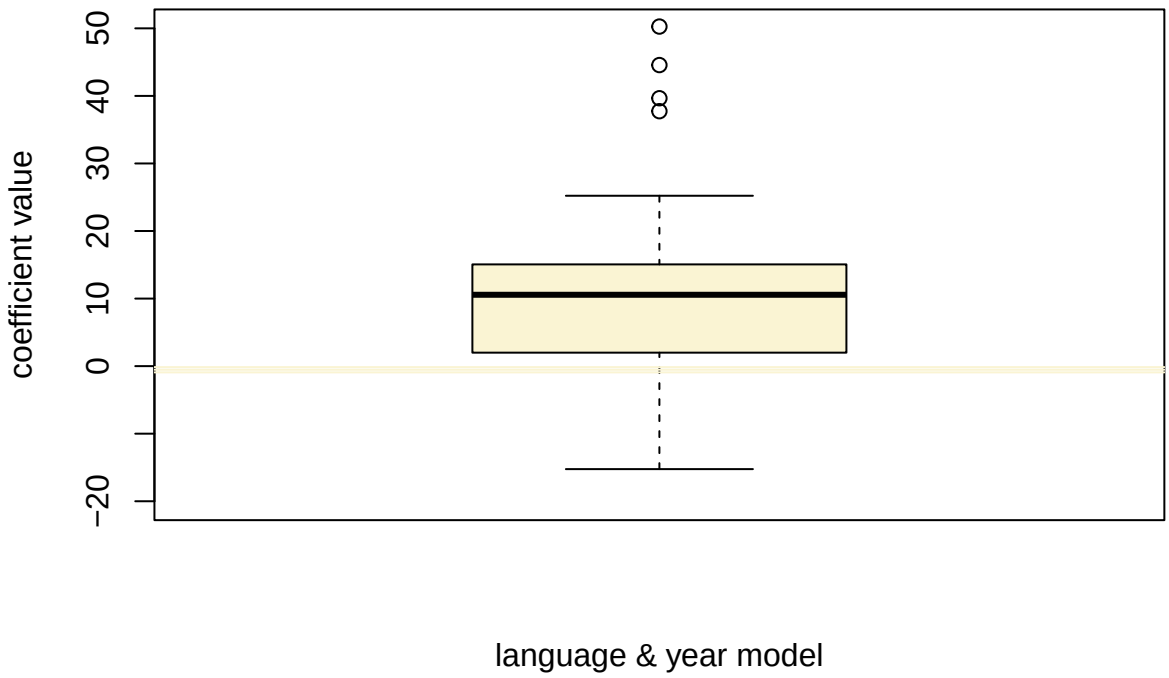
Language & Year

```
LY_model <- glm(
      formula = binconcepts ~
                french + german + firsty + secondy + thirdy +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(LY_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ french + german + firsty + secondy +
##     thirdy + greengreen_other + greenred_other + notgreennotred_other +
##     noobserved_other + greengreen_concentration + greenred_concentration +
##     notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.2731  -0.7879  -0.3285   0.7965   2.1657
##
## Coefficients: (3 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -15.2453    28.5048  -0.535   0.5928
## french                        -0.1446     0.3865  -0.374   0.7082
## german                            NA         NA      NA       NA
## firsty                        -0.9230     0.4824  -1.913   0.0557 .
## secondy                       -0.5334     0.4718  -1.131   0.2582
## thirdy                            NA         NA      NA       NA
## greengreen_other              11.5903    35.1470   0.330   0.7416
## greenred_other                11.8973    30.3477   0.392   0.6950
## notgreennotred_other           0.2170    29.7695   0.007   0.9942
## noobserved_other               0.4396    28.7077   0.015   0.9878
## greengreen_concentration      10.7707    28.5239   0.378   0.7057
## greenred_concentration        10.3554    28.3008   0.366   0.7144
```

```
## notgreennotred_concentration   5.7762    28.4095   0.203   0.8389
## noobserved_concentration      11.4472    28.5362   0.401   0.6883
## greengreen_width              -3.0214    33.1993  -0.091   0.9275
## greenred_width                 3.5488    27.8411   0.127   0.8986
## notgreennotred_width          13.0883    29.0245   0.451   0.6520
## noobserved_width               7.9651    28.4546   0.280   0.7795
## greengreen_wavelength         24.1623    35.0341   0.690   0.4904
## greenred_wavelength           12.7020    28.5401   0.445   0.6563
## notgreennotred_wavelength      8.0256    28.7043   0.280   0.7798
## noobserved_wavelength         14.7916    28.3890   0.521   0.6023
## greengreen_solution           44.5650    42.4943   1.049   0.2943
## greenred_solution             10.0998    28.3212   0.357   0.7214
## notgreennotred_solution       -0.6595    29.1914  -0.023   0.9820
## noobserved_solution           13.8150    28.5848   0.483   0.6289
## greengreen_pdf                15.3281    33.6647   0.455   0.6489
## greenred_pdf                   5.9351    28.8836   0.205   0.8372
## notgreennotred_pdf            19.0297    29.7467   0.640   0.5224
## noobserved_pdf                 9.2137    29.1754   0.316   0.7522
## greengreen_break              50.2674    37.6470   1.335   0.1818
## greenred_break                39.6546    31.5071   1.259   0.2082
## notgreennotred_break          37.7379    31.7222   1.190   0.2342
## noobserved_break              25.2193    30.9902   0.814   0.4158
## concentrationlab                  NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 250.30  on 222  degrees of freedom
## AIC: 314.3
##
## Number of Fisher Scoring iterations: 5
```

```
LY_coeffs = coef(LY_model)
boxplot(
  LY_coeffs,
  xlab='language & year model',
  ylim=c(-20, 50), ylab='coefficient value', col='#FAF4D3'
)
abline(h=LY_coeffs['french'], col='#FAF4D3')
abline(h=LY_coeffs['german'], col='#FAF4D3')
abline(h=LY_coeffs['thirdy'], col='#FAF4D3')
abline(h=LY_coeffs['firsty'], col='#FAF4D3')
abline(h=LY_coeffs['secondy'], col='#FAF4D3')
```



Language & Gender

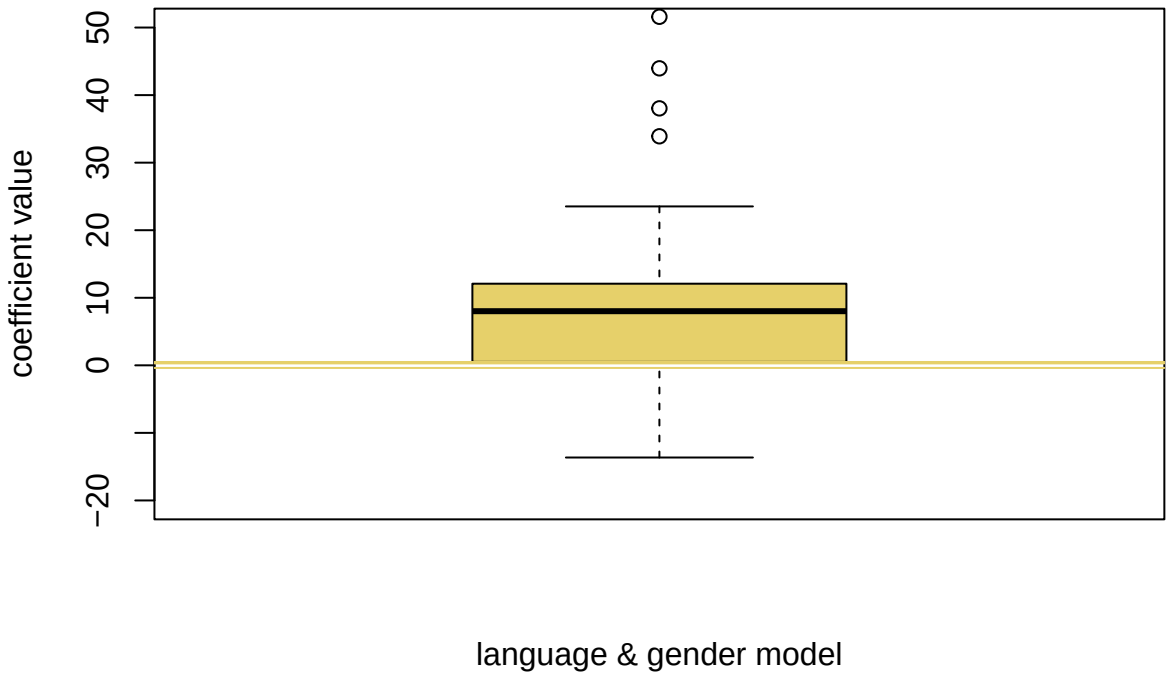
```
LG_model <- glm(
      formula = binconcepts ~
                french + german + female + male + other +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(LG_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ french + german + female + male +
##     other + greengreen_other + greenred_other + notgreennotred_other +
##     noobserved_other + greengreen_concentration + greenred_concentration +
```

```
##     notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0953  -0.7815  -0.3448   0.8539   2.2124
##
## Coefficients: (3 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -13.6452    23.8259  -0.573    0.567
## french                        -0.3871     0.3608  -1.073    0.283
## german                            NA         NA      NA       NA
## female                         0.4941     0.8905   0.555    0.579
## male                           0.2879     0.8865   0.325    0.745
## other                             NA         NA      NA       NA
## greengreen_other               9.3010    32.2807   0.288    0.773
## greenred_other                 9.2780    25.3603   0.366    0.714
## notgreennotred_other          -1.6019    25.5005  -0.063    0.950
## noobserved_other              -1.8288    24.0886  -0.076    0.939
## greengreen_concentration       8.5913    24.0150   0.358    0.721
## greenred_concentration         7.4923    23.6567   0.317    0.751
## notgreennotred_concentration   3.2088    23.7807   0.135    0.893
## noobserved_concentration       8.5336    23.8600   0.358    0.721
## greengreen_width              -3.6055    29.2633  -0.123    0.902
## greenred_width                 0.5242    23.3970   0.022    0.982
## notgreennotred_width          11.8145    24.4095   0.484    0.628
## noobserved_width               5.1992    23.8319   0.218    0.827
## greengreen_wavelength         20.6687    31.0694   0.665    0.506
## greenred_wavelength           10.9094    24.0304   0.454    0.650
## notgreennotred_wavelength      5.2774    24.1311   0.219    0.827
## noobserved_wavelength         12.3542    23.6932   0.521    0.602
## greengreen_solution           51.5944    39.8139   1.296    0.195
## greenred_solution              7.4464    23.7737   0.313    0.754
## notgreennotred_solution       -2.1551    24.8447  -0.087    0.931
## noobserved_solution           10.7451    23.8940   0.450    0.653
## greengreen_pdf                11.6814    29.9413   0.390    0.696
## greenred_pdf                   3.8790    24.2835   0.160    0.873
## notgreennotred_pdf            17.5473    25.4495   0.689    0.491
## noobserved_pdf                 6.0647    24.6366   0.246    0.806
## greengreen_break              43.9601    33.4928   1.313    0.189
## greenred_break                38.0384    26.9391   1.412    0.158
## notgreennotred_break          33.9034    27.2715   1.243    0.214
## noobserved_break              23.5210    26.4846   0.888    0.374
## concentrationlab                  NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
```

```
## Residual deviance: 253.56  on 222  degrees of freedom
## AIC: 317.56
##
## Number of Fisher Scoring iterations: 5
```

```
LG_coeffs = coef(LG_model)
boxplot(
  LG_coeffs,
  xlab='language & gender model',
  ylim=c(-20, 50), ylab='coefficient value', col='#E6D06A'
)
abline(h=LG_coeffs['french'], col='#E6D06A')
abline(h=LG_coeffs['german'], col='#E6D06A')
abline(h=LG_coeffs['female'], col='#E6D06A')
abline(h=LG_coeffs['male'], col='#E6D06A')
abline(h=LG_coeffs['other'], col='#E6D06A')
```



Language and Field

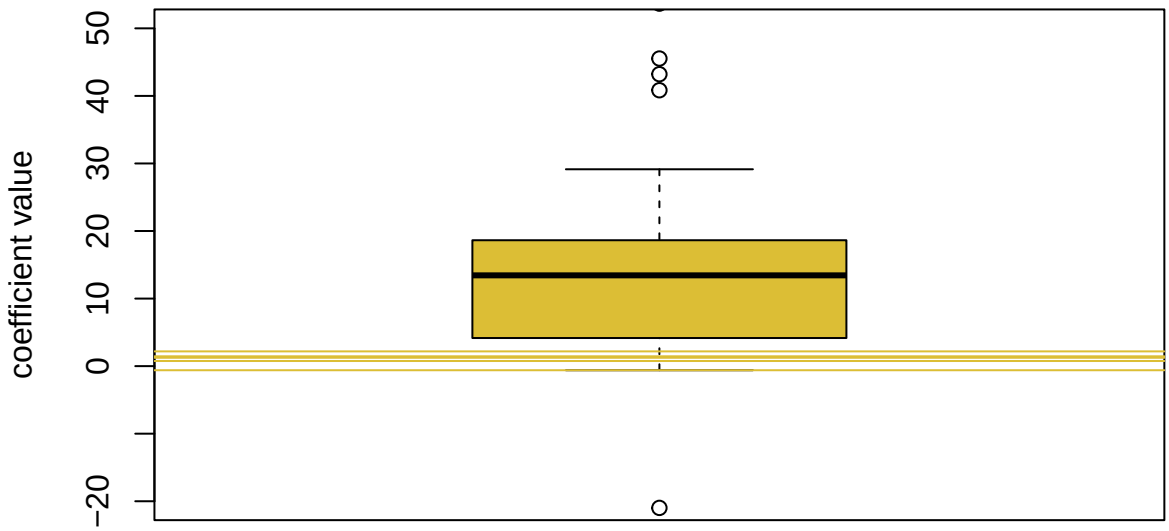
```
LF_model <- glm(
      formula = binconcepts ~
                french + german + chemistry + textiles + biology + fast + pharma +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
```

```
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(LF_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ french + german + chemistry + textiles +
##     biology + fast + pharma + greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.1033  -0.7281  -0.2907   0.8194   2.0036
##
## Coefficients: (3 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -20.9846    32.7892  -0.640   0.5222
## french                        -0.6069     0.4193  -1.447   0.1478
## german                            NA         NA      NA       NA
## chemistry                      2.1846     1.1826   1.847   0.0647 .
## textiles                       1.4520     1.2017   1.208   0.2269
## biology                        0.7561     1.3446   0.562   0.5739
## fast                           1.2376     1.7545   0.705   0.4806
## pharma                            NA         NA      NA       NA
## greengreen_other              14.1902    38.4509   0.369   0.7121
## greenred_other                14.1050    34.7587   0.406   0.6849
## notgreennotred_other           3.6827    33.7248   0.109   0.9130
## noobserved_other               4.1595    32.8352   0.127   0.8992
## greengreen_concentration      16.6938    32.6166   0.512   0.6088
## greenred_concentration        12.7675    32.3825   0.394   0.6934
## notgreennotred_concentration   9.4343    32.4722   0.291   0.7714
## noobserved_concentration      14.6309    32.6079   0.449   0.6537
## greengreen_width               8.8251    36.8654   0.239   0.8108
## greenred_width                 6.4499    31.7740   0.203   0.8391
## notgreennotred_width          18.3013    33.1845   0.551   0.5813
## noobserved_width              10.7877    32.4579   0.332   0.7396
## greengreen_wavelength         22.0577    38.0598   0.580   0.5622
```

```
## greenred_wavelength           17.7078    32.5792   0.544   0.5868
## notgreennotred_wavelength      8.9932    32.6817   0.275   0.7832
## noobserved_wavelength         17.7324    32.4596   0.546   0.5849
## greengreen_solution           53.6597    45.9893   1.167   0.2433
## greenred_solution             15.2737    32.4055   0.471   0.6374
## notgreennotred_solution        1.6657    33.1893   0.050   0.9600
## noobserved_solution           18.6351    32.7382   0.569   0.5692
## greengreen_pdf                23.0610    37.6296   0.613   0.5400
## greenred_pdf                   8.4242    32.9577   0.256   0.7983
## notgreennotred_pdf            25.5633    33.6895   0.759   0.4480
## noobserved_pdf                11.9520    33.2573   0.359   0.7193
## greengreen_break              43.2142    41.2026   1.049   0.2943
## greenred_break                45.5330    35.9928   1.265   0.2058
## notgreennotred_break          40.8379    36.0859   1.132   0.2578
## noobserved_break              29.1377    35.3353   0.825   0.4096
## concentrationlab                  NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 243.45  on 220  degrees of freedom
## AIC: 311.45
##
## Number of Fisher Scoring iterations: 6
```

```
LF_coeffs = coef(LF_model)
boxplot(
  LF_coeffs,
  xlab='language & field model',
  ylim=c(-20, 50), ylab='coefficient value', col='#DCBE35'
)
abline(h=LF_coeffs['french'], col='#DCBE35')
abline(h=LF_coeffs['german'], col='#DCBE35')
abline(h=LF_coeffs['chemistry'], col='#DCBE35')
abline(h=LF_coeffs['textiles'], col='#DCBE35')
abline(h=LF_coeffs['biology'], col='#DCBE35')
abline(h=LF_coeffs['fast'], col='#DCBE35')
abline(h=LF_coeffs['pharma'], col='#DCBE35')
```



Year & Gender

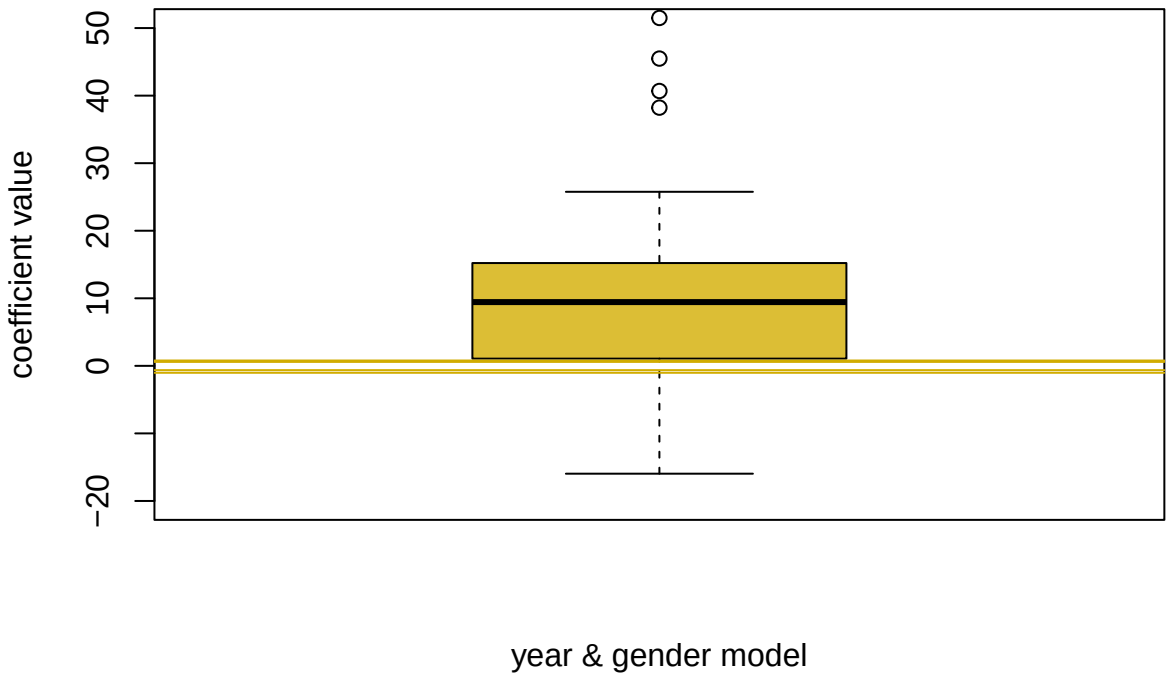
```
YG_model <- glm(
      formula = binconcepts ~
                firsty + secondy + thirdy + male + female + other +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wa
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(YG_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ firsty + secondy + thirdy + male +
##     female + other + greengreen_other + greenred_other + notgreennotred_other +
##     noobserved_other + greengreen_concentration + greenred_concentration +
```

```
##     notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.3208  -0.8085  -0.3307   0.7945   2.2015
##
## Coefficients: (3 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -15.9626    28.4838  -0.560   0.5752
## firsty                        -1.0275     0.4574  -2.246   0.0247 *
## secondy                       -0.6371     0.4644  -1.372   0.1700
## thirdy                            NA         NA      NA       NA
## male                           0.5855     0.9210   0.636   0.5249
## female                         0.7902     0.9226   0.856   0.3917
## other                             NA         NA      NA       NA
## greengreen_other               9.4370    35.2189   0.268   0.7887
## greenred_other                12.1242    30.2762   0.400   0.6888
## notgreennotred_other           1.0677    29.7658   0.036   0.9714
## noobserved_other               0.1490    28.6581   0.005   0.9959
## greengreen_concentration      10.4180    28.4794   0.366   0.7145
## greenred_concentration        10.0430    28.2591   0.355   0.7223
## notgreennotred_concentration   5.7028    28.3605   0.201   0.8406
## noobserved_concentration      11.2395    28.5010   0.394   0.6933
## greengreen_width              -3.9630    33.1035  -0.120   0.9047
## greenred_width                 3.1076    27.8240   0.112   0.9111
## notgreennotred_width          12.5270    28.9650   0.432   0.6654
## noobserved_width               8.1201    28.4559   0.285   0.7754
## greengreen_wavelength         23.6632    35.0092   0.676   0.4991
## greenred_wavelength           13.6059    28.5699   0.476   0.6339
## notgreennotred_wavelength      7.7833    28.6545   0.272   0.7859
## noobserved_wavelength         15.2158    28.3505   0.537   0.5915
## greengreen_solution           45.4865    42.5310   1.069   0.2848
## greenred_solution              9.2102    28.2839   0.326   0.7447
## notgreennotred_solution       -0.2335    29.1989  -0.008   0.9936
## noobserved_solution           13.5232    28.5485   0.474   0.6357
## greengreen_pdf                17.0134    33.8604   0.502   0.6153
## greenred_pdf                   5.3764    28.7775   0.187   0.8518
## notgreennotred_pdf            18.1228    29.6598   0.611   0.5412
## noobserved_pdf                 9.1390    29.1067   0.314   0.7535
## greengreen_break              51.4957    37.8855   1.359   0.1741
## greenred_break                40.6860    31.4499   1.294   0.1958
## notgreennotred_break          38.2232    31.7271   1.205   0.2283
## noobserved_break              25.7641    30.9219   0.833   0.4047
## concentrationlab                  NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 249.49  on 221  degrees of freedom
## AIC: 315.49
##
## Number of Fisher Scoring iterations: 6
```

```
YG_coeffs = coef(YG_model)
boxplot(
  YG_coeffs,
  xlab='year & gender model',
  ylim=c(-20, 50), ylab='coefficient value', col='#DCBE35'
)
abline(h=YG_coeffs['firsty'], col='#D1AC00')
abline(h=YG_coeffs['secondy'], col='#D1AC00')
abline(h=YG_coeffs['thirdy'], col='#D1AC00')
abline(h=YG_coeffs['female'], col='#D1AC00')
abline(h=YG_coeffs['male'], col='#D1AC00')
abline(h=YG_coeffs['other'], col='#D1AC00')
```



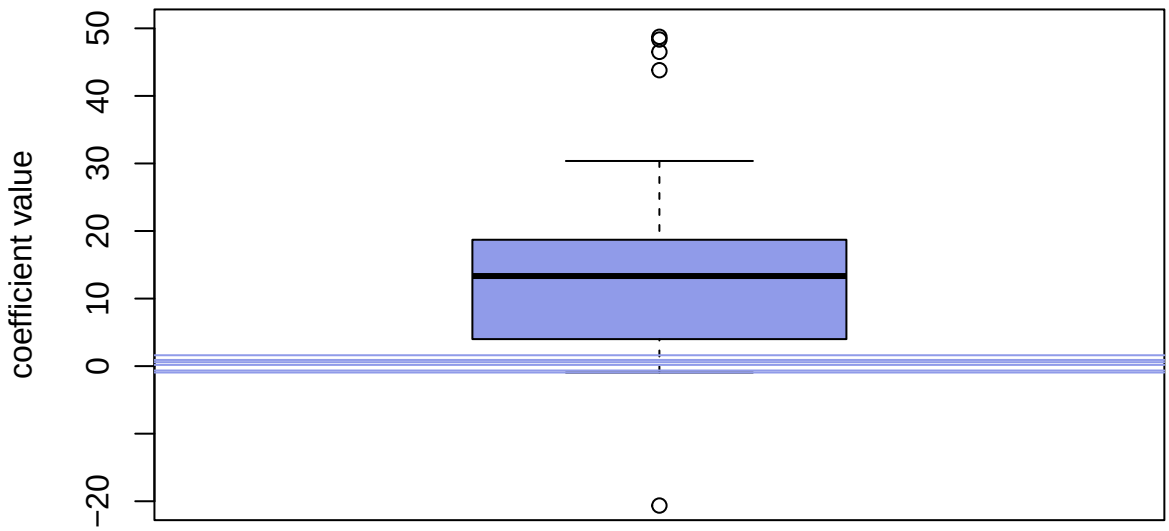
Year & Field

```
YF_model <- glm(
      formula = binconcepts ~
                firsty + secondy + thirdy + chemistry + textiles + biology + fast + pharma +
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wav
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(YF_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ firsty + secondy + thirdy + chemistry +
##     textiles + biology + fast + pharma + greengreen_other + greenred_other +
##     notgreennotred_other + noobserved_other + greengreen_concentration +
##     greenred_concentration + notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0589  -0.7482  -0.2862   0.7731   2.0729
##
## Coefficients: (3 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -20.6371    34.8912  -0.591    0.554
## firsty                        -0.9432     0.4915  -1.919    0.055 .
## secondy                       -0.6493     0.5001  -1.298    0.194
## thirdy                            NA         NA      NA       NA
## chemistry                      1.6094     1.2003   1.341    0.180
## textiles                       0.9142     1.2457   0.734    0.463
## biology                        0.1801     1.3617   0.132    0.895
## fast                           0.5851     1.7176   0.341    0.733
## pharma                            NA         NA      NA       NA
## greengreen_other              13.6449    39.7958   0.343    0.732
## greenred_other                14.4105    37.0978   0.388    0.698
## notgreennotred_other           4.0653    35.6830   0.114    0.909
## noobserved_other               3.9295    34.9620   0.112    0.911
## greengreen_concentration      16.4254    34.6858   0.474    0.636
## greenred_concentration        13.3364    34.5124   0.386    0.699
## notgreennotred_concentration   9.7248    34.5861   0.281    0.779
## noobserved_concentration      15.0722    34.7665   0.434    0.665
```

```
## greengreen_width               6.5814    38.7019   0.170    0.865
## greenred_width                 7.0017    33.8471   0.207    0.836
## notgreennotred_width          16.7600    35.2627   0.475    0.635
## noobserved_width              11.7294    34.6003   0.339    0.735
## greengreen_wavelength         26.0141    40.2881   0.646    0.518
## greenred_wavelength           18.2054    34.6563   0.525    0.599
## notgreennotred_wavelength      9.2017    34.7964   0.264    0.791
## noobserved_wavelength         18.5605    34.6259   0.536    0.592
## greengreen_solution           48.3428    47.1920   1.024    0.306
## greenred_solution             14.9525    34.4778   0.434    0.665
## notgreennotred_solution        1.2285    35.1786   0.035    0.972
## noobserved_solution           18.8524    34.8945   0.540    0.589
## greengreen_pdf                24.5169    39.5744   0.620    0.536
## greenred_pdf                   8.0314    34.9780   0.230    0.818
## notgreennotred_pdf            24.1236    35.6440   0.677    0.499
## noobserved_pdf                12.6962    35.3401   0.359    0.719
## greengreen_break              48.7491    43.5790   1.119    0.263
## greenred_break                46.5196    38.0226   1.223    0.221
## notgreennotred_break          43.8059    38.2114   1.146    0.252
## noobserved_break              30.3659    37.3477   0.813    0.416
## concentrationlab                  NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 241.78  on 219  degrees of freedom
## AIC: 311.78
##
## Number of Fisher Scoring iterations: 6
```

```
YF_coeffs = coef(YF_model)
boxplot(
  YF_coeffs,
  xlab='year & field model',
  ylim=c(-20, 50), ylab='coefficient value', col='#909be9'
)
abline(h=YF_coeffs['firsty'], col='#909be9')
abline(h=YF_coeffs['secondy'], col='#909be9')
abline(h=YF_coeffs['thirdy'], col='#909be9')
abline(h=YF_coeffs['chemistry'], col='#909be9')
abline(h=YF_coeffs['textiles'], col='#909be9')
abline(h=YF_coeffs['biology'], col='#909be9')
abline(h=YF_coeffs['pharma'], col='#909be9')
abline(h=YF_coeffs['fast'], col='#909be9')
```



ALL

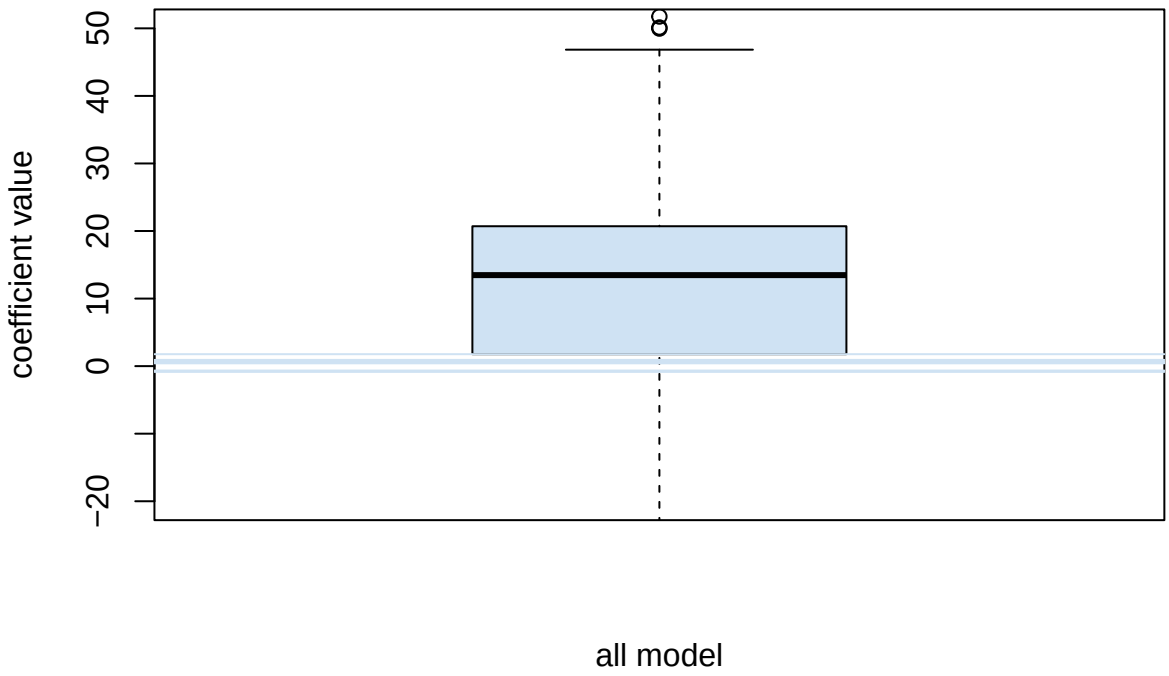
```
ALL_model <- glm(
      formula = binconcepts ~
                french + german + firsty + secondy + thirdy + female + male + other + chemistry + textil
                greengreen_other + greenred_other + notgreennotred_other + noobserved_other +
                greengreen_concentration + greenred_concentration + notgreennotred_concentration + noobs
                greengreen_width + greenred_width + notgreennotred_width + noobserved_width +
                greengreen_wavelength + greenred_wavelength + notgreennotred_wavelength + noobserved_wav
                greengreen_solution + greenred_solution + notgreennotred_solution + noobserved_solution
                greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
                greengreen_break + greenred_break + notgreennotred_break + noobserved_break +
                concentrationlab,
      data = action_count,
      family=binomial
    )
summary(ALL_model)
```

```
##
## Call:
## glm(formula = binconcepts ~ french + german + firsty + secondy +
##     thirdy + female + male + other + chemistry + textiles + biology +
##     fast + pharma + greengreen_other + greenred_other + notgreennotred_other +
```

```
##     noobserved_other + greengreen_concentration + greenred_concentration +
##     notgreennotred_concentration + noobserved_concentration +
##     greengreen_width + greenred_width + notgreennotred_width +
##     noobserved_width + greengreen_wavelength + greenred_wavelength +
##     notgreennotred_wavelength + noobserved_wavelength + greengreen_solution +
##     greenred_solution + notgreennotred_solution + noobserved_solution +
##     greengreen_pdf + greenred_pdf + notgreennotred_pdf + noobserved_pdf +
##     greengreen_break + greenred_break + notgreennotred_break +
##     noobserved_break + concentrationlab, family = binomial, data = action_count)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.1298  -0.7171  -0.2948   0.7648   2.0606
##
## Coefficients: (5 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -23.3487    37.6715  -0.620    0.535
## french                        -0.3642     0.4504  -0.809    0.419
## german                            NA         NA      NA       NA
## firsty                        -0.8544     0.5219  -1.637    0.102
## secondy                       -0.6563     0.5165  -1.271    0.204
## thirdy                            NA         NA      NA       NA
## female                         0.5962     1.0375   0.575    0.566
## male                           0.4696     1.0303   0.456    0.649
## other                             NA         NA      NA       NA
## chemistry                      1.7666     1.2493   1.414    0.157
## textiles                       0.9216     1.2635   0.729    0.466
## biology                        0.4189     1.4208   0.295    0.768
## fast                           0.7431     1.8263   0.407    0.684
## pharma                            NA         NA      NA       NA
## greengreen_other              13.3346    42.2659   0.315    0.752
## greenred_other                16.3192    39.8938   0.409    0.682
## notgreennotred_other           7.0721    38.3013   0.185    0.854
## noobserved_other               5.4682    37.6675   0.145    0.885
## greengreen_concentration      18.1449    37.3689   0.486    0.627
## greenred_concentration        15.0006    37.2138   0.403    0.687
## notgreennotred_concentration  11.6007    37.2630   0.311    0.756
## noobserved_concentration      16.7824    37.4786   0.448    0.654
## greengreen_width               8.1350    41.1895   0.198    0.843
## greenred_width                 8.7083    36.4729   0.239    0.811
## notgreennotred_width          18.3060    37.9561   0.482    0.630
## noobserved_width              13.6092    37.2921   0.365    0.715
## greengreen_wavelength         23.4565    42.5043   0.552    0.581
## greenred_wavelength           20.4640    37.3617   0.548    0.584
## notgreennotred_wavelength     10.9464    37.4098   0.293    0.770
## noobserved_wavelength         20.7063    37.3050   0.555    0.579
## greengreen_solution           50.1313    49.2778   1.017    0.309
## greenred_solution             16.2721    37.1971   0.437    0.662
## notgreennotred_solution        3.5805    37.8234   0.095    0.925
## noobserved_solution           20.8554    37.6612   0.554    0.580
## greengreen_pdf                27.1953    41.9350   0.649    0.517
## greenred_pdf                  10.4057    37.6997   0.276    0.783
## notgreennotred_pdf            26.1970    38.2763   0.684    0.494
## noobserved_pdf                14.7835    38.0354   0.389    0.698
```

```
## greengreen_break              51.7513    46.2362   1.119    0.263
## greenred_break                49.9667    40.8392   1.223    0.221
## notgreennotred_break          46.8445    41.0275   1.142    0.254
## noobserved_break              33.1233    40.0324   0.827    0.408
## concentrationlab                   NA         NA      NA       NA
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 348.08  on 253  degrees of freedom
## Residual deviance: 240.51  on 216  degrees of freedom
## AIC: 316.51
##
## Number of Fisher Scoring iterations: 6
```

```
ALL_coeffs = coef(ALL_model)
boxplot(
  ALL_coeffs,
  xlab='all model',
  ylim=c(-20, 50), ylab='coefficient value', col='#cfe2f3'
)
abline(h=ALL_coeffs['firsty'], col='#cfe2f3')
abline(h=ALL_coeffs['secondy'], col='#cfe2f3')
abline(h=ALL_coeffs['thirdy'], col='#cfe2f3')
abline(h=ALL_coeffs['chemistry'], col='#cfe2f3')
abline(h=ALL_coeffs['textiles'], col='#cfe2f3')
abline(h=ALL_coeffs['biology'], col='#cfe2f3')
abline(h=ALL_coeffs['pharma'], col='#cfe2f3')
abline(h=ALL_coeffs['fast'], col='#cfe2f3')
abline(h=ALL_coeffs['female'], col='#cfe2f3')
abline(h=ALL_coeffs['male'], col='#cfe2f3')
abline(h=ALL_coeffs['other'], col='#cfe2f3')
```




```
action_count
```

```
##       X      lid greengreen_other greenred_other notgreennotred_other
## 1     0 svdphyjs      0.115789474    0.063157895          0.021052632
## 2     1 gc663sap      0.000000000    0.015625000          0.000000000
## 3     2 8nh4zvcp      0.000000000    0.019607843          0.000000000
## 4     3 5f4q4ng5      0.000000000    0.013698630          0.075342466
## 5     4 ujpk3gf4      0.000000000    0.044444444          0.000000000
## 6     5 5zrt4f8z      0.000000000    0.017543860          0.000000000
## 7     6 xvsgn53d      0.000000000    0.028735632          0.000000000
## 8     7 qsd9cb5e      0.028708134    0.000000000          0.000000000
## 9     8 cp7mfn24      0.000000000    0.083333333          0.000000000
## 10    9 j9qgkaej      0.000000000    0.000000000          0.006849315
## 11   10 85pdk9mq      0.000000000    0.000000000          0.000000000
## 12   11 k7p5eryf      0.000000000    0.000000000          0.000000000
## 13   12 wktpsvp8      0.000000000    0.047058824          0.000000000
## 14   13 mnhmyuhb      0.000000000    0.038461538          0.000000000
## 15   14 tsrnkj8w      0.000000000    0.068493151          0.000000000
## 16   15 favvtnnf      0.000000000    0.000000000          0.000000000
## 17   16 fh76v5qx      0.005586592    0.000000000          0.000000000
## 18   17 t6rjyw6s      0.000000000    0.000000000          0.000000000
## 19   18 vhsgf3xa      0.000000000    0.068965517          0.000000000
## 20   19 5h9umyr6      0.000000000    0.050000000          0.000000000
## 21   20 mhek2323      0.021739130    0.021739130          0.000000000
## 22   21 caq55qe8      0.017699115    0.000000000          0.061946903
## 23   22 drccqhk4      0.000000000    0.033333333          0.000000000
```

```
## 24   23 ur9sxzx7      0.000000000    0.051282051          0.000000000
## 25   24 jx3yyy26      0.000000000    0.027027027          0.000000000
## 26   25 upp6pqmx      0.000000000    0.002812940          0.000000000
## 27   26 bebyve9b      0.000000000    0.036866359          0.000000000
## 28   27 uswb2jez      0.000000000    0.035714286          0.000000000
## 29   28 upkt7qb4      0.000000000    0.006756757          0.000000000
## 30   29 wpszzhxa      0.000000000    0.025641026          0.000000000
## 31   30 84nmc3df      0.000000000    0.009771987          0.000000000
## 32   31 urwu33jd      0.000000000    0.060606061          0.000000000
## 33   32 4k4kc2k6      0.000000000    0.060606061          0.000000000
## 34   33 o9ffsiwt      0.000000000    0.035087719          0.000000000
## 35   34 6j6u2yct      0.000000000    0.000000000          0.000000000
## 36   35 bqmcqxyx      0.000000000    0.030303030          0.000000000
## 37   36 sgsxmkfm      0.000000000    0.000000000          0.000000000
## 38   37 bezdgyya      0.000000000    0.000000000          0.000000000
## 39   38 6z7nfy2j      0.009708738    0.019417476          0.000000000
## 40   39 eb9iv6v2      0.000000000    0.035087719          0.000000000
## 41   40 dubyutqd      0.000000000    0.000000000          0.012820513
## 42   41 3st3y5gc      0.000000000    0.010928962          0.000000000
## 43   42 2xjmtbvz      0.000000000    0.217391304          0.000000000
## 44   43 9aagpn4d      0.000000000    0.000000000          0.038461538
## 45   44 ujp9fgpn      0.000000000    0.000000000          0.000000000
## 46   45 evqzjs5p      0.012500000    0.000000000          0.025000000
## 47   46 smqjhu44      0.000000000    0.016949153          0.000000000
## 48   47 fyf6ag5v      0.000000000    0.026315789          0.000000000
## 49   48 h543nsc8      0.000000000    0.000000000          0.088888889
## 50   49 r2q9q35x      0.000000000    0.000000000          0.000000000
## 51   50 4rhnvke9      0.000000000    0.042553191          0.000000000
## 52   51 cdq4drkk      0.000000000    0.000000000          0.009523810
## 53   52 mzjq6z9t      0.000000000    0.000000000          0.022222222
## 54   53 mp2aa258      0.000000000    0.000000000          0.000000000
## 55   54 unkrat9w      0.000000000    0.152173913          0.000000000
## 56   55 e22ppyf7      0.000000000    0.057692308          0.025641026
## 57   56 xsxkdf7k      0.000000000    0.026490066          0.000000000
## 58   57 yc3vmnuf      0.000000000    0.065217391          0.000000000
## 59   58 xdxyjh8j      0.000000000    0.018939394          0.026515152
## 60   59 mwfdr4ys      0.000000000    0.040322581          0.000000000
## 61   60 6tg95rzr      0.030303030    0.030303030          0.000000000
## 62   61 fj5tdybn      0.000000000    0.018867925          0.000000000
## 63   62 7xhcecye      0.000000000    0.044444444          0.000000000
## 64   63 xj86wyup      0.000000000    0.069767442          0.069767442
## 65   64 tsvcrpeg      0.000000000    0.000000000          0.072164948
## 66   65 h9t9mxtx      0.000000000    0.044444444          0.000000000
## 67   66 ht865nws      0.000000000    0.005681818          0.011363636
## 68   67 sgdgynxy      0.000000000    0.080808081          0.000000000
## 69   68 suyrrcqe      0.000000000    0.136363636          0.000000000
## 70   69 4bu2rkv3      0.000000000    0.000000000          0.000000000
## 71   70 2crhmbq7      0.000000000    0.100000000          0.000000000
## 72   71 dbt5na3s      0.000000000    0.006818182          0.006818182
## 73   72 gvqh7qr2      0.000000000    0.005291005          0.026455026
## 74   73 wger3sfa      0.014814815    0.059259259          0.000000000
## 75   74 4k4dk9pu      0.000000000    0.060000000          0.000000000
## 76   75 qkeyp2rg      0.000000000    0.000000000          0.000000000
## 77   76 qsx2cc4b      0.012578616    0.000000000          0.000000000
```

```
## 78   77 6uakv8nx      0.000000000    0.000000000          0.000000000
## 79   78 6fkbh35u      0.000000000    0.086538462          0.000000000
## 80   79 9bp6yz7m      0.001754386    0.007017544          0.000000000
## 81   80 fm5rcvdy      0.000000000    0.165680473          0.059171598
## 82   81 r29wzm6f      0.000000000    0.010695187          0.010695187
## 83   82 y7p64n6z      0.000000000    0.044444444          0.000000000
## 84   83 b72hbgvw      0.000000000    0.093750000          0.000000000
## 85   84 sjz2rptd      0.000000000    0.024096386          0.000000000
## 86   85 mcjaj2aj      0.000000000    0.019607843          0.000000000
## 87   86 temu2736      0.000000000    0.094339623          0.094339623
## 88   87 w7asnymz      0.000000000    0.052083333          0.010416667
## 89   88 2hr6mkdc      0.000000000    0.004651163          0.000000000
## 90   89 m3d89p29      0.000000000    0.010526316          0.000000000
## 91   90 egg8756y      0.000000000    0.069767442          0.000000000
## 92   91 chm4sr6j      0.000000000    0.032258065          0.032258065
## 93   92 baqyfz2h      0.000000000    0.000000000          0.000000000
## 94   93 h75kp27p      0.000000000    0.000000000          0.056603774
## 95   94 26z3wbqz      0.000000000    0.043478261          0.000000000
## 96   95 ybxahrra      0.000000000    0.000000000          0.006756757
## 97   96 6h5vmwys      0.000000000    0.000000000          0.000000000
## 98   97 rgeb7wr9      0.000000000    0.009708738          0.000000000
## 99   98 u25vrfyy      0.000000000    0.021739130          0.000000000
## 100  99 rrykpeqz      0.000000000    0.011235955          0.000000000
## 101 100 xz56yha8      0.000000000    0.060810811          0.000000000
## 102 101 bg7x3db2      0.000000000    0.005347594          0.000000000
## 103 102 ky8kttpv      0.000000000    0.016129032          0.000000000
## 104 103 zgyc948n      0.000000000    0.000000000          0.027777778
## 105 104 c9dj36r7      0.000000000    0.000000000          0.013333333
## 106 105 4zsmj6s3      0.000000000    0.069230769          0.015384615
## 107 106 hf8uz5t3      0.000000000    0.000000000          0.118421053
## 108 107 rdy7sx9b      0.000000000    0.025641026          0.000000000
## 109 108 tvtbbfhg      0.000000000    0.066666667          0.000000000
## 110 109 g6z8qykr      0.000000000    0.029629630          0.000000000
## 111 110 rve4n5nv      0.000000000    0.000000000          0.003831418
## 112 111 nw65tu6j      0.000000000    0.000000000          0.007407407
## 113 112 rjx9d3gf      0.000000000    0.060606061          0.000000000
## 114 113 v5w2e3zw      0.000000000    0.052631579          0.000000000
## 115 114 beypwbck      0.000000000    0.037037037          0.000000000
## 116 115 p6mkaa4e      0.000000000    0.000000000          0.000000000
## 117 116 uqw5vh3j      0.008474576    0.033898305          0.000000000
## 118 117 p6269reg      0.000000000    0.000000000          0.000000000
## 119 118 wnurkn96      0.000000000    0.000000000          0.000000000
## 120 119 nsj6k2rg      0.000000000    0.007092199          0.000000000
## 121 120 v5gwycag      0.000000000    0.000000000          0.015228426
## 122 121 e3b96acv      0.015625000    0.000000000          0.015625000
## 123 122 uqven68r      0.000000000    0.111111111          0.000000000
## 124 123 m35ub35g      0.000000000    0.014705882          0.014705882
## 125 124 5es5yqs8      0.000000000    0.043478261          0.014492754
## 126 125 ydws5xx9      0.000000000    0.027027027          0.000000000
## 127 126 wxz98urt      0.000000000    0.012121212          0.000000000
## 128 127 39htvmt5      0.017857143    0.035714286          0.000000000
## 129 128 qk6q49f4      0.006289308    0.006289308          0.031446541
## 130 129 jhrkm85q      0.027777778    0.000000000          0.027777778
## 131 130 4jchqv4d      0.000000000    0.047058824          0.000000000
```

```
## 132 131 sx3vqc32      0.000000000    0.042553191          0.000000000
## 133 132 5m3ka2m2      0.000000000    0.032258065          0.006451613
## 134 133 edmrufua      0.000000000    0.012987013          0.000000000
## 135 134 zs35fg8g      0.000000000    0.000000000          0.000000000
## 136 135 9p9gwu88      0.038461538    0.038461538          0.000000000
## 137 136 xpyjyx4m      0.000000000    0.027027027          0.000000000
## 138 137 p5t7d3sb      0.014634146    0.000000000          0.000000000
## 139 138 fryxwskq      0.000000000    0.000000000          0.000000000
## 140 139 aurjfgnn      0.000000000    0.023255814          0.000000000
## 141 140 892r4czm      0.000000000    0.013513514          0.013513514
## 142 141 jydsy777      0.000000000    0.000000000          0.000000000
## 143 142 xw9qt6r4      0.000000000    0.035714286          0.000000000
## 144 143 uqzxsym7      0.000000000    0.088888889          0.000000000
## 145 144 w25mph3c      0.012987013    0.000000000          0.000000000
## 146 145 wbdyh5vk      0.000000000    0.003333333          0.000000000
## 147 146 ecy9k833      0.000000000    0.018181818          0.000000000
## 148 147 b2q8ay65      0.000000000    0.026666667          0.000000000
## 149 148 ay2erc3c      0.000000000    0.074074074          0.000000000
## 150 149 v2cxb3a5      0.000000000    0.027027027          0.027027027
## 151 150 ytrbygud      0.000000000    0.148760331          0.000000000
## 152 151 hkvk9vt9      0.010101010    0.033670034          0.023569024
## 153 152 sz8qvgyv      0.000000000    0.000000000          0.000000000
## 154 153 araav4jr      0.000000000    0.000000000          0.000000000
## 155 154 jwajupwj      0.000000000    0.005988024          0.005988024
## 156 155 s8w65sm5      0.000000000    0.000000000          0.000000000
## 157 156 j6nndaxp      0.000000000    0.035714286          0.000000000
## 158 157 nba9d6t2      0.000000000    0.088235294          0.000000000
## 159 158 x5sm9pfu      0.000000000    0.125000000          0.000000000
## 160 159 jwntt96k      0.000000000    0.003322259          0.000000000
## 161 160 x844md8u      0.000000000    0.025000000          0.025000000
## 162 161 uenn9vgu      0.000000000    0.000000000          0.000000000
## 163 162 rdbqasqa      0.000000000    0.024875622          0.000000000
## 164 163 p44vw7td      0.000000000    0.005952381          0.000000000
## 165 164 2ejxq2u8      0.000000000    0.000000000          0.037037037
## 166 165 fu6nsdhs      0.000000000    0.004926108          0.000000000
## 167 166 55yavcue      0.000000000    0.000000000          0.000000000
## 168 167 9pjrsbth      0.000000000    0.013071895          0.000000000
## 169 168 982cf4dn      0.000000000    0.030303030          0.000000000
## 170 169 jkbx6axr      0.000000000    0.030303030          0.000000000
## 171 170 f54jkrsw      0.000000000    0.011111111          0.000000000
## 172 171 dq4zzkyt      0.000000000    0.000000000          0.020979021
## 173 172 uhbpoog9      0.000000000    0.000000000          0.000000000
## 174 173 vjr7tshm      0.000000000    0.031250000          0.031250000
## 175 174 nrxpa2ac      0.000000000    0.035714286          0.000000000
## 176 175 vwfpuqaz      0.000000000    0.055555556          0.000000000
## 177 176 8jp62suc      0.000000000    0.030303030          0.000000000
## 178 177 e93na59g      0.012195122    0.000000000          0.000000000
## 179 178 2ae6q3hw      0.010362694    0.041450777          0.000000000
## 180 179 43e33t3h      0.026315789    0.000000000          0.000000000
## 181 180 wvxkvhne      0.000000000    0.105263158          0.105263158
## 182 181 mkw5afyy      0.000000000    0.047619048          0.000000000
## 183 182 a3vdjxy9      0.000000000    0.000000000          0.009803922
## 184 183 7t9zwtmr      0.000000000    0.000000000          0.000000000
## 185 184 uhq3p7yr      0.000000000    0.000000000          0.000000000
```

```
## 186 185 mwwddfvg      0.000000000    0.008620690          0.017241379
## 187 186 3vsn2h9f      0.010752688    0.010752688          0.000000000
## 188 187 qdp9ant4      0.000000000    0.025641026          0.032051282
## 189 188 63xqh9t5      0.000000000    0.024390244          0.000000000
## 190 189 r74r26kt      0.000000000    0.018518519          0.046296296
## 191 190 tcnba4ca      0.000000000    0.063291139          0.126582278
## 192 191 fs32fqe3      0.000000000    0.000000000          0.000000000
## 193 192 nj859xxh      0.000000000    0.024390244          0.000000000
## 194 193 ntqpqkpq      0.000000000    0.034482759          0.000000000
## 195 194 gyerx2d9      0.000000000    0.022988506          0.011494253
## 196 195 e8zdytr2      0.000000000    0.000000000          0.000000000
## 197 196 cb6wcvyn      0.000000000    0.020833333          0.000000000
## 198 197 ew6cfr37      0.065934066    0.054945055          0.032967033
## 199 198 eau7bsmq      0.000000000    0.000000000          0.000000000
## 200 199 uthx49rq      0.000000000    0.012618297          0.018927445
## 201 200 76wvaew4      0.000000000    0.076923077          0.000000000
## 202 201 8ethqmkd      0.000000000    0.000000000          0.000000000
## 203 202 jvxejtp9      0.000000000    0.005780347          0.000000000
## 204 203 zgs84jfy      0.014925373    0.000000000          0.000000000
## 205 204 9sgu2tbg      0.000000000    0.041666667          0.041666667
## 206 205 9xc2v9vu      0.011173184    0.027932961          0.016759777
## 207 206 dk43m2pe      0.000000000    0.006060606          0.000000000
## 208 207 5a69aw4h      0.000000000    0.025000000          0.000000000
## 209 208 ryfqnvfh      0.000000000    0.036363636          0.036363636
## 210 209 4vtjgtja      0.000000000    0.023255814          0.000000000
## 211 210 sh6tu9g2      0.000000000    0.036585366          0.000000000
## 212 211 s2up6gmm      0.000000000    0.022346369          0.000000000
## 213 212 2xh9zuvc      0.005586592    0.061452514          0.000000000
## 214 213 xngb9hff      0.000000000    0.057142857          0.000000000
## 215 214 7fj2vydr      0.000000000    0.307692308          0.000000000
## 216 215 22wyn9xy      0.000000000    0.016393443          0.000000000
## 217 216 vqebanqv      0.000000000    0.043103448          0.000000000
## 218 217 fddsxudu      0.023255814    0.011627907          0.000000000
## 219 218 ke6msbfr      0.000000000    0.000000000          0.037735849
## 220 219 zxp438xr      0.000000000    0.000000000          0.052631579
## 221 220 m9u6p93a      0.000000000    0.095238095          0.000000000
## 222 221 4rjjdez9      0.000000000    0.021276596          0.021276596
## 223 222 yez72a8b      0.000000000    0.047619048          0.000000000
## 224 223 tzpqpfaa      0.000000000    0.000000000          0.000000000
## 225 224 tt5n8d2r      0.000000000    0.000000000          0.000000000
## 226 225 5j7hdews      0.032258065    0.032258065          0.000000000
## 227 226 sm8sfpcg      0.000000000    0.062500000          0.000000000
## 228 227 s7mdq5tk      0.000000000    0.018518519          0.037037037
## 229 228 5y535ct3      0.000000000    0.000000000          0.075949367
## 230 229 djnysnd6      0.004975124    0.014925373          0.000000000
## 231 230 fzagvhvf      0.000000000    0.000000000          0.024096386
## 232 231 s78drqcg      0.000000000    0.085106383          0.021276596
## 233 232 t3dwkezr      0.000000000    0.004651163          0.000000000
## 234 233 qjfn2j8z      0.000000000    0.100000000          0.000000000
## 235 234 47ce49e4      0.000000000    0.005263158          0.000000000
## 236 235 g4xpwwac      0.000000000    0.000000000          0.000000000
## 237 236 9wdm7zue      0.000000000    0.037500000          0.025000000
## 238 237 szvqb37f      0.000000000    0.027027027          0.000000000
## 239 238 hrhu4yph      0.000000000    0.038461538          0.192307692
```

```
## 240 239 q4z45p85      0.000000000    0.000000000          0.036496350
## 241 240 u6c3cp6c      0.000000000    0.033333333          0.000000000
## 242 241 r78kg7d3      0.000000000    0.010238908          0.000000000
## 243 242 6bq62prp      0.000000000    0.054054054          0.000000000
## 244 243 4vuc8rr3      0.000000000    0.000000000          0.000000000
## 245 244 gpq26qq9      0.003460208    0.003460208          0.000000000
## 246 245 dmdc53tx      0.000000000    0.166666667          0.000000000
## 247 246 d7777ske      0.000000000    0.000000000          0.000000000
## 248 247 oikzz9af      0.000000000    0.000000000          0.000000000
## 249 248 m4zvafhs      0.000000000    0.005952381          0.000000000
## 250 249 m749z8u9      0.000000000    0.008515815          0.000000000
## 251 250 88kjzd8b      0.000000000    0.016949153          0.000000000
## 252 251 zkrr45y5      0.000000000    0.000000000          0.000000000
## 253 252 26mtbtye      0.000000000    0.000000000          0.000000000
## 254 253 4e438nww      0.000000000    0.007177033          0.031100478
##     noobserved_other greengreen_concentration greenred_concentration
## 1        0.031578947              0.021052632            0.052631579
## 2        0.031250000              0.000000000            0.000000000
## 3        0.098039216              0.000000000            0.000000000
## 4        0.150684932              0.000000000            0.000000000
## 5        0.044444444              0.000000000            0.088888889
## 6        0.070175439              0.017543860            0.140350877
## 7        0.034482759              0.000000000            0.568965517
## 8        0.009569378              0.234449761            0.043062201
## 9        0.166666667              0.000000000            0.000000000
## 10       0.013698630              0.020547945            0.075342466
## 11       0.086956522              0.000000000            0.000000000
## 12       0.055555556              0.000000000            0.000000000
## 13       0.050980392              0.035294118            0.035294118
## 14       0.038461538              0.000000000            0.038461538
## 15       0.109589041              0.000000000            0.054794521
## 16       0.020000000              0.000000000            0.000000000
## 17       0.005586592              0.100558659            0.279329609
## 18       0.055555556              0.055555556            0.055555556
## 19       0.000000000              0.000000000            0.103448276
## 20       0.000000000              0.000000000            0.000000000
## 21       0.043478261              0.010869565            0.163043478
## 22       0.026548673              0.000000000            0.000000000
## 23       0.100000000              0.000000000            0.100000000
## 24       0.025641026              0.000000000            0.153846154
## 25       0.108108108              0.000000000            0.000000000
## 26       0.000000000              0.000000000            0.420534459
## 27       0.041474654              0.000000000            0.004608295
## 28       0.017857143              0.000000000            0.035714286
## 29       0.047297297              0.047297297            0.074324324
## 30       0.076923077              0.000000000            0.128205128
## 31       0.003257329              0.006514658            0.250814332
## 32       0.030303030              0.000000000            0.151515152
## 33       0.030303030              0.030303030            0.090909091
## 34       0.210526316              0.000000000            0.000000000
## 35       0.150000000              0.000000000            0.000000000
## 36       0.030303030              0.000000000            0.030303030
## 37       0.062500000              0.000000000            0.000000000
## 38       0.036585366              0.000000000            0.000000000
```

```
## 39       0.019417476          0.029126214          0.223300971
## 40       0.000000000          0.000000000          0.105263158
## 41       0.166666667          0.000000000          0.000000000
## 42       0.024590164          0.000000000          0.587431694
## 43       0.043478261          0.072463768          0.028985507
## 44       0.076923077          0.000000000          0.000000000
## 45       0.097560976          0.000000000          0.000000000
## 46       0.037500000          0.012500000          0.000000000
## 47       0.050847458          0.000000000          0.101694915
## 48       0.078947368          0.000000000          0.052631579
## 49       0.111111111          0.000000000          0.000000000
## 50       0.017543860          0.000000000          0.000000000
## 51       0.085106383          0.000000000          0.063829787
## 52       0.047619048          0.019047619          0.038095238
## 53       0.022222222          0.044444444          0.022222222
## 54       0.078125000          0.000000000          0.000000000
## 55       0.130434783          0.000000000          0.000000000
## 56       0.089743590          0.006410256          0.038461538
## 57       0.039735099          0.000000000          0.145695364
## 58       0.195652174          0.000000000          0.000000000
## 59       0.007575758          0.000000000          0.000000000
## 60       0.032258065          0.000000000          0.258064516
## 61       0.090909091          0.090909091          0.060606061
## 62       0.000000000          0.000000000          0.056603774
## 63       0.022222222          0.088888889          0.111111111
## 64       0.000000000          0.000000000          0.023255814
## 65       0.113402062          0.000000000          0.000000000
## 66       0.133333333          0.000000000          0.066666667
## 67       0.017045455          0.119318182          0.073863636
## 68       0.060606061          0.050505051          0.050505051
## 69       0.045454545          0.000000000          0.000000000
## 70       0.092592593          0.000000000          0.000000000
## 71       0.050000000          0.000000000          0.000000000
## 72       0.013636364          0.134090909          0.356818182
## 73       0.026455026          0.000000000          0.010582011
## 74       0.022222222          0.074074074          0.051851852
## 75       0.000000000          0.000000000          0.040000000
## 76       0.300000000          0.000000000          0.000000000
## 77       0.012578616          0.025157233          0.037735849
## 78       0.037037037          0.000000000          0.333333333
## 79       0.038461538          0.000000000          0.105769231
## 80       0.010526316          0.245614035          0.338596491
## 81       0.065088757          0.000000000          0.029585799
## 82       0.037433155          0.000000000          0.000000000
## 83       0.111111111          0.000000000          0.000000000
## 84       0.156250000          0.000000000          0.031250000
## 85       0.024096386          0.012048193          0.084337349
## 86       0.039215686          0.000000000          0.137254902
## 87       0.037735849          0.000000000          0.037735849
## 88       0.010416667          0.083333333          0.083333333
## 89       0.013953488          0.000000000          0.409302326
## 90       0.010526316          0.000000000          0.200000000
## 91       0.116279070          0.000000000          0.069767442
## 92       0.000000000          0.000000000          0.064516129
```

```
## 93       0.020253165          0.000000000          0.453164557
## 94       0.000000000          0.000000000          0.000000000
## 95       0.043478261          0.000000000          0.000000000
## 96       0.047297297          0.000000000          0.000000000
## 97       0.194444444          0.000000000          0.000000000
## 98       0.019417476          0.009708738          0.213592233
## 99       0.021739130          0.000000000          0.260869565
## 100      0.067415730          0.000000000          0.146067416
## 101      0.006756757          0.000000000          0.000000000
## 102      0.010695187          0.000000000          0.000000000
## 103      0.026881720          0.005376344          0.209677419
## 104      0.000000000          0.000000000          0.000000000
## 105      0.111111111          0.000000000          0.000000000
## 106      0.007692308          0.007692308          0.007692308
## 107      0.013157895          0.000000000          0.000000000
## 108      0.128205128          0.000000000          0.000000000
## 109      0.033333333          0.000000000          0.166666667
## 110      0.096296296          0.000000000          0.044444444
## 111      0.019157088          0.490421456          0.000000000
## 112      0.037037037          0.000000000          0.014814815
## 113      0.060606061          0.000000000          0.090909091
## 114      0.026315789          0.013157895          0.197368421
## 115      0.037037037          0.000000000          0.037037037
## 116      0.078431373          0.000000000          0.019607843
## 117      0.000000000          0.000000000          0.110169492
## 118      0.181818182          0.000000000          0.000000000
## 119      0.082191781          0.000000000          0.000000000
## 120      0.014184397          0.007092199          0.333333333
## 121      0.065989848          0.000000000          0.000000000
## 122      0.046875000          0.000000000          0.000000000
## 123      0.000000000          0.000000000          0.097222222
## 124      0.000000000          0.014705882          0.102941176
## 125      0.246376812          0.000000000          0.000000000
## 126      0.000000000          0.000000000          0.175675676
## 127      0.018181818          0.000000000          0.721212121
## 128      0.089285714          0.000000000          0.000000000
## 129      0.025157233          0.106918239          0.031446541
## 130      0.000000000          0.000000000          0.000000000
## 131      0.047058824          0.000000000          0.117647059
## 132      0.021276596          0.000000000          0.106382979
## 133      0.038709677          0.000000000          0.025806452
## 134      0.012987013          0.000000000          0.318181818
## 135      0.090909091          0.000000000          0.045454545
## 136      0.000000000          0.038461538          0.038461538
## 137      0.054054054          0.000000000          0.378378378
## 138      0.019512195          0.390243902          0.058536585
## 139      0.000000000          0.000000000          0.000000000
## 140      0.046511628          0.000000000          0.046511628
## 141      0.040540541          0.000000000          0.027027027
## 142      0.023696682          0.000000000          0.000000000
## 143      0.000000000          0.035714286          0.071428571
## 144      0.133333333          0.000000000          0.022222222
## 145      0.077922078          0.025974026          0.000000000
## 146      0.013333333          0.000000000          0.020000000
```

```
## 147      0.054545455          0.090909091          0.018181818
## 148      0.080000000          0.000000000          0.013333333
## 149      0.037037037          0.000000000          0.296296296
## 150      0.135135135          0.000000000          0.054054054
## 151      0.008264463          0.280991736          0.066115702
## 152      0.033670034          0.037037037          0.164983165
## 153      0.047619048          0.000000000          0.000000000
## 154      0.070422535          0.000000000          0.366197183
## 155      0.011976048          0.113772455          0.035928144
## 156      0.060606061          0.000000000          0.000000000
## 157      0.107142857          0.000000000          0.107142857
## 158      0.029411765          0.000000000          0.014705882
## 159      0.000000000          0.000000000          0.062500000
## 160      0.043189369          0.003322259          0.013289037
## 161      0.150000000          0.000000000          0.000000000
## 162      0.000000000          0.000000000          0.000000000
## 163      0.069651741          0.000000000          0.000000000
## 164      0.000000000          0.000000000          0.476190476
## 165      0.296296296          0.000000000          0.000000000
## 166      0.004926108          0.019704433          0.059113300
## 167      0.120000000          0.000000000          0.000000000
## 168      0.045751634          0.000000000          0.339869281
## 169      0.030303030          0.000000000          0.030303030
## 170      0.015151515          0.000000000          0.000000000
## 171      0.011111111          0.000000000          0.000000000
## 172      0.076923077          0.000000000          0.000000000
## 173      0.277777778          0.000000000          0.000000000
## 174      0.000000000          0.000000000          0.000000000
## 175      0.035714286          0.071428571          0.035714286
## 176      0.277777778          0.000000000          0.055555556
## 177      0.000000000          0.060606061          0.030303030
## 178      0.012195122          0.390243902          0.036585366
## 179      0.036269430          0.056994819          0.113989637
## 180      0.105263158          0.000000000          0.013157895
## 181      0.105263158          0.000000000          0.210526316
## 182      0.095238095          0.000000000          0.000000000
## 183      0.019607843          0.058823529          0.088235294
## 184      0.040000000          0.000000000          0.146666667
## 185      0.068965517          0.000000000          0.000000000
## 186      0.017241379          0.008620690          0.060344828
## 187      0.021505376          0.086021505          0.129032258
## 188      0.000000000          0.006410256          0.083333333
## 189      0.024390244          0.000000000          0.146341463
## 190      0.037037037          0.000000000          0.018518519
## 191      0.063291139          0.000000000          0.012658228
## 192      0.148148148          0.000000000          0.000000000
## 193      0.024390244          0.000000000          0.195121951
## 194      0.275862069          0.000000000          0.000000000
## 195      0.137931034          0.000000000          0.000000000
## 196      0.285714286          0.000000000          0.000000000
## 197      0.166666667          0.000000000          0.000000000
## 198      0.087912088          0.120879121          0.098901099
## 199      0.027397260          0.246575342          0.000000000
## 200      0.018927445          0.000000000          0.009463722
```

```
## 201      0.000000000          0.000000000          0.115384615
## 202      0.166666667          0.000000000          0.000000000
## 203      0.011560694          0.450867052          0.034682081
## 204      0.059701493          0.000000000          0.000000000
## 205      0.208333333          0.000000000          0.041666667
## 206      0.039106145          0.022346369          0.022346369
## 207      0.024242424          0.000000000          0.036363636
## 208      0.075000000          0.000000000          0.100000000
## 209      0.090909091          0.000000000          0.018181818
## 210      0.069767442          0.000000000          0.023255814
## 211      0.036585366          0.000000000          0.024390244
## 212      0.005586592          0.245810056          0.134078212
## 213      0.005586592          0.000000000          0.156424581
## 214      0.028571429          0.000000000          0.028571429
## 215      0.076923077          0.000000000          0.000000000
## 216      0.016393443          0.000000000          0.032786885
## 217      0.051724138          0.086206897          0.051724138
## 218      0.046511628          0.000000000          0.011627907
## 219      0.018867925          0.000000000          0.075471698
## 220      0.078947368          0.000000000          0.000000000
## 221      0.071428571          0.000000000          0.047619048
## 222      0.021276596          0.000000000          0.042553191
## 223      0.047619048          0.000000000          0.000000000
## 224      0.161290323          0.000000000          0.000000000
## 225      0.062500000          0.000000000          0.000000000
## 226      0.064516129          0.000000000          0.000000000
## 227      0.031250000          0.000000000          0.125000000
## 228      0.050925926          0.000000000          0.004629630
## 229      0.050632911          0.000000000          0.025316456
## 230      0.019900498          0.000000000          0.313432836
## 231      0.036144578          0.000000000          0.000000000
## 232      0.106382979          0.000000000          0.021276596
## 233      0.037209302          0.000000000          0.479069767
## 234      0.040000000          0.000000000          0.000000000
## 235      0.015789474          0.073684211          0.073684211
## 236      0.052631579          0.000000000          0.000000000
## 237      0.050000000          0.012500000          0.312500000
## 238      0.067567568          0.000000000          0.067567568
## 239      0.000000000          0.000000000          0.115384615
## 240      0.058394161          0.000000000          0.000000000
## 241      0.016666667          0.000000000          0.050000000
## 242      0.013651877          0.013651877          0.436860068
## 243      0.054054054          0.000000000          0.216216216
## 244      0.129629630          0.000000000          0.000000000
## 245      0.017301038          0.003460208          0.013840830
## 246      0.000000000          0.000000000          0.041666667
## 247      0.157894737          0.000000000          0.000000000
## 248      0.000000000          0.000000000          0.000000000
## 249      0.029761905          0.000000000          0.428571429
## 250      0.000000000          0.590024331          0.107055961
## 251      0.033898305          0.118644068          0.203389831
## 252      0.025641026          0.000000000          0.000000000
## 253      0.045454545          0.000000000          0.000000000
## 254      0.014354067          0.000000000          0.000000000
```

```
##     notgreennotred_concentration noobserved_concentration greengreen_width
## 1                     0.010526316              0.000000000      0.010526316
## 2                     0.000000000              0.109375000      0.000000000
## 3                     0.000000000              0.313725490      0.000000000
## 4                     0.027397260              0.068493151      0.000000000
## 5                     0.000000000              0.177777778      0.000000000
## 6                     0.000000000              0.000000000      0.017543860
## 7                     0.000000000              0.000000000      0.000000000
## 8                     0.057416268              0.023923445      0.124401914
## 9                     0.000000000              0.083333333      0.000000000
## 10                    0.109589041              0.095890411      0.034246575
## 11                    0.000000000              0.217391304      0.000000000
## 12                    0.000000000              0.000000000      0.000000000
## 13                    0.000000000              0.121568627      0.003921569
## 14                    0.076923077              0.000000000      0.000000000
## 15                    0.013698630              0.102739726      0.000000000
## 16                    0.000000000              0.140000000      0.000000000
## 17                    0.005586592              0.022346369      0.033519553
## 18                    0.000000000              0.027777778      0.027777778
## 19                    0.000000000              0.000000000      0.000000000
## 20                    0.000000000              0.000000000      0.000000000
## 21                    0.000000000              0.108695652      0.032608696
## 22                    0.035398230              0.061946903      0.000000000
## 23                    0.000000000              0.000000000      0.000000000
## 24                    0.000000000              0.000000000      0.000000000
## 25                    0.054054054              0.013513514      0.000000000
## 26                    0.000000000              0.286919831      0.000000000
## 27                    0.000000000              0.437788018      0.000000000
## 28                    0.035714286              0.017857143      0.000000000
## 29                    0.141891892              0.000000000      0.020270270
## 30                    0.000000000              0.025641026      0.000000000
## 31                    0.241042345              0.003257329      0.006514658
## 32                    0.000000000              0.030303030      0.000000000
## 33                    0.000000000              0.030303030      0.060606061
## 34                    0.000000000              0.140350877      0.000000000
## 35                    0.000000000              0.050000000      0.000000000
## 36                    0.060606061              0.030303030      0.000000000
## 37                    0.000000000              0.437500000      0.000000000
## 38                    0.000000000              0.243902439      0.000000000
## 39                    0.038834951              0.019417476      0.009708738
## 40                    0.052631579              0.035087719      0.000000000
## 41                    0.000000000              0.307692308      0.000000000
## 42                    0.000000000              0.032786885      0.000000000
## 43                    0.014492754              0.000000000      0.000000000
## 44                    0.038461538              0.102564103      0.000000000
## 45                    0.000000000              0.073170732      0.000000000
## 46                    0.012500000              0.087500000      0.000000000
## 47                    0.000000000              0.033898305      0.000000000
## 48                    0.000000000              0.000000000      0.000000000
## 49                    0.066666667              0.000000000      0.000000000
## 50                    0.000000000              0.175438596      0.000000000
## 51                    0.000000000              0.127659574      0.000000000
## 52                    0.038095238              0.038095238      0.000000000
## 53                    0.022222222              0.022222222      0.066666667
```

```
## 54                0.000000000          0.093750000      0.000000000
## 55                0.000000000          0.065217391      0.000000000
## 56                0.051282051          0.019230769      0.000000000
## 57                0.006622517          0.013245033      0.000000000
## 58                0.000000000          0.086956522      0.000000000
## 59                0.450757576          0.000000000      0.000000000
## 60                0.000000000          0.185483871      0.000000000
## 61                0.000000000          0.000000000      0.121212121
## 62                0.000000000          0.000000000      0.037735849
## 63                0.022222222          0.000000000      0.000000000
## 64                0.255813953          0.023255814      0.000000000
## 65                0.000000000          0.154639175      0.000000000
## 66                0.000000000          0.000000000      0.000000000
## 67                0.295454545          0.005681818      0.005681818
## 68                0.040404040          0.000000000      0.050505051
## 69                0.000000000          0.000000000      0.000000000
## 70                0.000000000          0.111111111      0.000000000
## 71                0.000000000          0.000000000      0.000000000
## 72                0.086363636          0.006818182      0.000000000
## 73                0.105820106          0.428571429      0.000000000
## 74                0.000000000          0.000000000      0.037037037
## 75                0.020000000          0.060000000      0.000000000
## 76                0.000000000          0.000000000      0.000000000
## 77                0.000000000          0.421383648      0.025157233
## 78                0.000000000          0.037037037      0.000000000
## 79                0.000000000          0.019230769      0.000000000
## 80                0.000000000          0.085964912      0.000000000
## 81                0.029585799          0.000000000      0.000000000
## 82                0.149732620          0.037433155      0.000000000
## 83                0.000000000          0.155555556      0.000000000
## 84                0.000000000          0.000000000      0.000000000
## 85                0.000000000          0.000000000      0.000000000
## 86                0.000000000          0.098039216      0.000000000
## 87                0.056603774          0.018867925      0.000000000
## 88                0.020833333          0.010416667      0.010416667
## 89                0.116279070          0.000000000      0.000000000
## 90                0.000000000          0.031578947      0.000000000
## 91                0.000000000          0.023255814      0.000000000
## 92                0.000000000          0.000000000      0.000000000
## 93                0.005063291          0.086075949      0.000000000
## 94                0.037735849          0.000000000      0.000000000
## 95                0.086956522          0.000000000      0.000000000
## 96                0.000000000          0.493243243      0.000000000
## 97                0.000000000          0.083333333      0.000000000
## 98                0.000000000          0.009708738      0.000000000
## 99                0.000000000          0.021739130      0.000000000
## 100               0.000000000          0.303370787      0.000000000
## 101               0.000000000          0.459459459      0.000000000
## 102               0.000000000          0.588235294      0.000000000
## 103               0.016129032          0.091397849      0.005376344
## 104               0.069444444          0.013888889      0.041666667
## 105               0.000000000          0.142222222      0.000000000
## 106               0.115384615          0.000000000      0.000000000
## 107               0.065789474          0.105263158      0.000000000
```

```
## 108          0.025641026          0.000000000          0.000000000
## 109          0.000000000          0.000000000          0.000000000
## 110          0.000000000          0.037037037          0.000000000
## 111          0.007662835          0.019157088          0.042145594
## 112          0.148148148          0.229629630          0.000000000
## 113          0.000000000          0.000000000          0.000000000
## 114          0.000000000          0.000000000          0.013157895
## 115          0.111111111          0.037037037          0.000000000
## 116          0.000000000          0.176470588          0.000000000
## 117          0.008474576          0.008474576          0.000000000
## 118          0.000000000          0.090909091          0.000000000
## 119          0.000000000          0.136986301          0.000000000
## 120          0.000000000          0.035460993          0.021276596
## 121          0.000000000          0.269035533          0.000000000
## 122          0.000000000          0.000000000          0.046875000
## 123          0.013888889          0.013888889          0.000000000
## 124          0.088235294          0.000000000          0.000000000
## 125          0.014492754          0.173913043          0.000000000
## 126          0.000000000          0.000000000          0.000000000
## 127          0.000000000          0.000000000          0.000000000
## 128          0.000000000          0.107142857          0.000000000
## 129          0.094339623          0.000000000          0.006289308
## 130          0.055555556          0.027777778          0.000000000
## 131          0.011764706          0.058823529          0.011764706
## 132          0.042553191          0.000000000          0.000000000
## 133          0.058064516          0.006451613          0.000000000
## 134          0.000000000          0.032467532          0.000000000
## 135          0.090909091          0.000000000          0.000000000
## 136          0.000000000          0.076923077          0.076923077
## 137          0.000000000          0.000000000          0.000000000
## 138          0.000000000          0.034146341          0.053658537
## 139          0.000000000          0.285714286          0.000000000
## 140          0.000000000          0.023255814          0.000000000
## 141          0.162162162          0.000000000          0.000000000
## 142          0.000000000          0.691943128          0.000000000
## 143          0.035714286          0.000000000          0.000000000
## 144          0.000000000          0.000000000          0.000000000
## 145          0.000000000          0.012987013          0.025974026
## 146          0.486666667          0.000000000          0.003333333
## 147          0.000000000          0.018181818          0.018181818
## 148          0.000000000          0.266666667          0.000000000
## 149          0.000000000          0.000000000          0.000000000
## 150          0.054054054          0.027027027          0.000000000
## 151          0.000000000          0.000000000          0.000000000
## 152          0.020202020          0.000000000          0.010101010
## 153          0.000000000          0.095238095          0.000000000
## 154          0.000000000          0.042253521          0.000000000
## 155          0.131736527          0.023952096          0.047904192
## 156          0.000000000          0.090909091          0.000000000
## 157          0.000000000          0.000000000          0.000000000
## 158          0.000000000          0.088235294          0.000000000
## 159          0.000000000          0.000000000          0.000000000
## 160          0.242524917          0.106312292          0.006644518
## 161          0.000000000          0.050000000          0.000000000
```

```
## 162 0.000000000 0.000000000 0.000000000
## 163 0.000000000 0.398009950 0.000000000
## 164 0.023809524 0.000000000 0.000000000
## 165 0.037037037 0.074074074 0.000000000
## 166 0.182266010 0.059113300 0.009852217
## 167 0.000000000 0.100000000 0.000000000
## 168 0.000000000 0.156862745 0.000000000
## 169 0.000000000 0.181818182 0.000000000
## 170 0.000000000 0.000000000 0.000000000
## 171 0.155555556 0.377777778 0.000000000
## 172 0.000000000 0.496503497 0.000000000
## 173 0.000000000 0.055555556 0.000000000
## 174 0.000000000 0.000000000 0.000000000
## 175 0.000000000 0.000000000 0.000000000
## 176 0.000000000 0.000000000 0.000000000
## 177 0.000000000 0.060606061 0.060606061
## 178 0.000000000 0.000000000 0.048780488
## 179 0.010362694 0.093264249 0.020725389
## 180 0.000000000 0.105263158 0.000000000
## 181 0.000000000 0.052631579 0.000000000
## 182 0.000000000 0.000000000 0.000000000
## 183 0.225490196 0.000000000 0.000000000
## 184 0.000000000 0.013333333 0.000000000
## 185 0.000000000 0.103448276 0.000000000
## 186 0.155172414 0.000000000 0.043103448
## 187 0.075268817 0.000000000 0.021505376
## 188 0.083333333 0.000000000 0.000000000
## 189 0.000000000 0.000000000 0.000000000
## 190 0.138888889 0.000000000 0.000000000
## 191 0.012658228 0.012658228 0.000000000
## 192 0.000000000 0.000000000 0.000000000
## 193 0.000000000 0.000000000 0.000000000
## 194 0.000000000 0.000000000 0.000000000
## 195 0.000000000 0.068965517 0.000000000
## 196 0.000000000 0.285714286 0.000000000
## 197 0.000000000 0.041666667 0.000000000
## 198 0.000000000 0.000000000 0.000000000
## 199 0.000000000 0.000000000 0.068493151
## 200 0.340694006 0.113564669 0.000000000
## 201 0.000000000 0.038461538 0.000000000
## 202 0.000000000 0.055555556 0.000000000
## 203 0.000000000 0.000000000 0.011560694
## 204 0.000000000 0.298507463 0.000000000
## 205 0.083333333 0.000000000 0.000000000
## 206 0.027932961 0.000000000 0.022346369
## 207 0.090909091 0.212121212 0.000000000
## 208 0.000000000 0.125000000 0.000000000
## 209 0.254545455 0.018181818 0.000000000
## 210 0.000000000 0.000000000 0.000000000
## 211 0.012195122 0.085365854 0.012195122
## 212 0.078212291 0.061452514 0.005586592
## 213 0.039106145 0.011173184 0.005586592
## 214 0.000000000 0.000000000 0.000000000
## 215 0.000000000 0.025641026 0.000000000
```

```
## 216                 0.032786885             0.000000000      0.000000000
## 217                 0.215517241             0.094827586      0.000000000
## 218                 0.000000000             0.313953488      0.000000000
## 219                 0.094339623             0.000000000      0.000000000
## 220                 0.000000000             0.026315789      0.000000000
## 221                 0.000000000             0.000000000      0.000000000
## 222                 0.085106383             0.000000000      0.000000000
## 223                 0.000000000             0.000000000      0.000000000
## 224                 0.000000000             0.032258065      0.000000000
## 225                 0.000000000             0.458333333      0.000000000
## 226                 0.032258065             0.032258065      0.000000000
## 227                 0.031250000             0.031250000      0.000000000
## 228                 0.027777778             0.277777778      0.000000000
## 229                 0.025316456             0.025316456      0.000000000
## 230                 0.064676617             0.099502488      0.009950249
## 231                 0.000000000             0.289156627      0.000000000
## 232                 0.000000000             0.000000000      0.000000000
## 233                 0.000000000             0.088372093      0.000000000
## 234                 0.000000000             0.000000000      0.000000000
## 235                 0.263157895             0.000000000      0.078947368
## 236                 0.000000000             0.052631579      0.000000000
## 237                 0.000000000             0.000000000      0.012500000
## 238                 0.013513514             0.013513514      0.000000000
## 239                 0.000000000             0.076923077      0.000000000
## 240                 0.197080292             0.021897810      0.000000000
## 241                 0.000000000             0.300000000      0.000000000
## 242                 0.000000000             0.003412969      0.013651877
## 243                 0.000000000             0.027027027      0.000000000
## 244                 0.000000000             0.129629630      0.000000000
## 245                 0.003460208             0.487889273      0.000000000
## 246                 0.083333333             0.000000000      0.000000000
## 247                 0.000000000             0.157894737      0.000000000
## 248                 0.000000000             0.000000000      0.000000000
## 249                 0.005952381             0.023809524      0.000000000
## 250                 0.000000000             0.000000000      0.002433090
## 251                 0.000000000             0.000000000      0.067796610
## 252                 0.000000000             0.128205128      0.000000000
## 253                 0.000000000             0.000000000      0.000000000
## 254                 0.291866029             0.220095694      0.000000000
##     greenred_width notgreennotred_width noobserved_width greengreen_wavelength
## 1      0.052631579          0.010526316      0.031578947           0.000000000
## 2      0.000000000          0.000000000      0.109375000           0.000000000
## 3      0.000000000          0.000000000      0.107843137           0.000000000
## 4      0.000000000          0.006849315      0.013698630           0.000000000
## 5      0.088888889          0.000000000      0.000000000           0.000000000
## 6      0.035087719          0.000000000      0.087719298           0.000000000
## 7      0.017241379          0.000000000      0.017241379           0.000000000
## 8      0.023923445          0.000000000      0.014354067           0.000000000
## 9      0.027777778          0.000000000      0.138888889           0.000000000
## 10     0.027397260          0.089041096      0.013698630           0.006849315
## 11     0.000000000          0.000000000      0.217391304           0.000000000
## 12     0.000000000          0.000000000      0.222222222           0.000000000
## 13     0.027450980          0.000000000      0.031372549           0.003921569
## 14     0.019230769          0.115384615      0.019230769           0.000000000
```

```
## 15     0.089041096          0.006849315      0.102739726          0.000000000
## 16     0.000000000          0.000000000      0.060000000          0.000000000
## 17     0.000000000          0.000000000      0.011173184          0.000000000
## 18     0.083333333          0.000000000      0.055555556          0.027777778
## 19     0.137931034          0.000000000      0.034482759          0.000000000
## 20     0.000000000          0.000000000      0.000000000          0.000000000
## 21     0.010869565          0.010869565      0.010869565          0.010869565
## 22     0.000000000          0.088495575      0.000000000          0.000000000
## 23     0.066666667          0.000000000      0.133333333          0.000000000
## 24     0.230769231          0.000000000      0.000000000          0.000000000
## 25     0.027027027          0.162162162      0.081081081          0.000000000
## 26     0.008438819          0.000000000      0.004219409          0.000000000
## 27     0.000000000          0.000000000      0.041474654          0.013824885
## 28     0.000000000          0.000000000      0.017857143          0.000000000
## 29     0.033783784          0.020270270      0.013513514          0.006756757
## 30     0.076923077          0.000000000      0.051282051          0.000000000
## 31     0.029315961          0.003257329      0.091205212          0.000000000
## 32     0.090909091          0.000000000      0.060606061          0.000000000
## 33     0.060606061          0.000000000      0.060606061          0.000000000
## 34     0.000000000          0.000000000      0.087719298          0.000000000
## 35     0.000000000          0.000000000      0.200000000          0.000000000
## 36     0.000000000          0.000000000      0.030303030          0.000000000
## 37     0.000000000          0.000000000      0.031250000          0.015625000
## 38     0.000000000          0.000000000      0.219512195          0.000000000
## 39     0.009708738          0.009708738      0.019417476          0.009708738
## 40     0.087719298          0.070175439      0.070175439          0.035087719
## 41     0.000000000          0.000000000      0.025641026          0.000000000
## 42     0.021857923          0.000000000      0.013661202          0.000000000
## 43     0.014492754          0.000000000      0.043478261          0.014492754
## 44     0.000000000          0.038461538      0.128205128          0.000000000
## 45     0.000000000          0.000000000      0.097560976          0.000000000
## 46     0.000000000          0.025000000      0.087500000          0.037500000
## 47     0.084745763          0.000000000      0.016949153          0.016949153
## 48     0.000000000          0.000000000      0.105263158          0.000000000
## 49     0.000000000          0.200000000      0.066666667          0.000000000
## 50     0.000000000          0.000000000      0.210526316          0.000000000
## 51     0.085106383          0.000000000      0.063829787          0.000000000
## 52     0.009523810          0.028571429      0.038095238          0.000000000
## 53     0.088888889          0.044444444      0.022222222          0.044444444
## 54     0.000000000          0.000000000      0.109375000          0.000000000
## 55     0.021739130          0.000000000      0.108695652          0.000000000
## 56     0.044871795          0.019230769      0.012820513          0.006410256
## 57     0.019867550          0.000000000      0.006622517          0.000000000
## 58     0.000000000          0.000000000      0.043478261          0.000000000
## 59     0.007575758          0.026515152      0.007575758          0.000000000
## 60     0.008064516          0.000000000      0.040322581          0.000000000
## 61     0.000000000          0.000000000      0.000000000          0.030303030
## 62     0.150943396          0.018867925      0.056603774          0.037735849
## 63     0.066666667          0.000000000      0.000000000          0.022222222
## 64     0.046511628          0.023255814      0.046511628          0.000000000
## 65     0.000000000          0.041237113      0.061855670          0.000000000
## 66     0.088888889          0.000000000      0.066666667          0.000000000
## 67     0.000000000          0.045454545      0.011363636          0.000000000
## 68     0.050505051          0.000000000      0.010101010          0.010101010
```

```
## 69     0.136363636          0.000000000      0.000000000          0.000000000
## 70     0.000000000          0.000000000      0.222222222          0.000000000
## 71     0.000000000          0.000000000      0.000000000          0.000000000
## 72     0.025000000          0.002272727      0.006818182          0.002272727
## 73     0.005291005          0.021164021      0.021164021          0.000000000
## 74     0.059259259          0.000000000      0.007407407          0.000000000
## 75     0.060000000          0.000000000      0.000000000          0.020000000
## 76     0.000000000          0.000000000      0.150000000          0.000000000
## 77     0.018867925          0.000000000      0.031446541          0.000000000
## 78     0.129629630          0.000000000      0.018518519          0.000000000
## 79     0.211538462          0.000000000      0.038461538          0.000000000
## 80     0.003508772          0.000000000      0.010526316          0.001754386
## 81     0.023668639          0.017751479      0.053254438          0.000000000
## 82     0.016042781          0.037433155      0.064171123          0.000000000
## 83     0.000000000          0.000000000      0.044444444          0.000000000
## 84     0.093750000          0.000000000      0.062500000          0.000000000
## 85     0.048192771          0.000000000      0.048192771          0.000000000
## 86     0.117647059          0.000000000      0.039215686          0.000000000
## 87     0.000000000          0.094339623      0.037735849          0.000000000
## 88     0.020833333          0.010416667      0.062500000          0.041666667
## 89     0.009302326          0.000000000      0.009302326          0.000000000
## 90     0.147368421          0.000000000      0.042105263          0.000000000
## 91     0.116279070          0.000000000      0.093023256          0.000000000
## 92     0.032258065          0.000000000      0.000000000          0.000000000
## 93     0.012658228          0.000000000      0.037974684          0.000000000
## 94     0.000000000          0.301886792      0.075471698          0.018867925
## 95     0.086956522          0.043478261      0.000000000          0.000000000
## 96     0.000000000          0.000000000      0.047297297          0.006756757
## 97     0.000000000          0.000000000      0.138888889          0.000000000
## 98     0.048543689          0.000000000      0.009708738          0.019417476
## 99     0.108695652          0.000000000      0.065217391          0.000000000
## 100    0.011235955          0.000000000      0.089887640          0.000000000
## 101    0.081081081          0.000000000      0.000000000          0.006756757
## 102    0.000000000          0.000000000      0.032085561          0.000000000
## 103    0.037634409          0.010752688      0.080645161          0.000000000
## 104    0.000000000          0.027777778      0.000000000          0.000000000
## 105    0.000000000          0.004444444      0.115555556          0.000000000
## 106    0.015384615          0.000000000      0.000000000          0.000000000
## 107    0.000000000          0.052631579      0.026315789          0.000000000
## 108    0.000000000          0.000000000      0.102564103          0.000000000
## 109    0.233333333          0.000000000      0.000000000          0.000000000
## 110    0.081481481          0.000000000      0.037037037          0.000000000
## 111    0.000000000          0.011494253      0.026819923          0.007662835
## 112    0.000000000          0.029629630      0.037037037          0.000000000
## 113    0.060606061          0.000000000      0.000000000          0.000000000
## 114    0.105263158          0.000000000      0.000000000          0.000000000
## 115    0.000000000          0.185185185      0.074074074          0.000000000
## 116    0.039215686          0.000000000      0.078431373          0.000000000
## 117    0.084745763          0.000000000      0.000000000          0.000000000
## 118    0.000000000          0.000000000      0.090909091          0.000000000
## 119    0.000000000          0.000000000      0.068493151          0.000000000
## 120    0.063829787          0.007092199      0.014184397          0.000000000
## 121    0.000000000          0.000000000      0.142131980          0.000000000
## 122    0.031250000          0.015625000      0.046875000          0.015625000
```

```
## 123    0.125000000          0.055555556      0.013888889          0.000000000
## 124    0.058823529          0.000000000      0.000000000          0.000000000
## 125    0.028985507          0.000000000      0.072463768          0.000000000
## 126    0.027027027          0.000000000      0.000000000          0.000000000
## 127    0.000000000          0.000000000      0.024242424          0.000000000
## 128    0.017857143          0.000000000      0.017857143          0.017857143
## 129    0.018867925          0.075471698      0.006289308          0.012578616
## 130    0.027777778          0.194444444      0.055555556          0.027777778
## 131    0.035294118          0.000000000      0.035294118          0.000000000
## 132    0.063829787          0.021276596      0.000000000          0.000000000
## 133    0.038709677          0.012903226      0.045161290          0.000000000
## 134    0.084415584          0.000000000      0.025974026          0.000000000
## 135    0.000000000          0.000000000      0.090909091          0.000000000
## 136    0.038461538          0.000000000      0.000000000          0.000000000
## 137    0.162162162          0.000000000      0.000000000          0.000000000
## 138    0.024390244          0.000000000      0.019512195          0.009756098
## 139    0.000000000          0.000000000      0.000000000          0.000000000
## 140    0.069767442          0.023255814      0.023255814          0.000000000
## 141    0.027027027          0.000000000      0.027027027          0.000000000
## 142    0.000000000          0.000000000      0.023696682          0.000000000
## 143    0.000000000          0.000000000      0.000000000          0.035714286
## 144    0.088888889          0.000000000      0.133333333          0.000000000
## 145    0.000000000          0.000000000      0.129870130          0.051948052
## 146    0.010000000          0.036666667      0.033333333          0.003333333
## 147    0.036363636          0.018181818      0.018181818          0.000000000
## 148    0.000000000          0.000000000      0.013333333          0.000000000
## 149    0.129629630          0.000000000      0.055555556          0.000000000
## 150    0.027027027          0.000000000      0.108108108          0.000000000
## 151    0.000000000          0.000000000      0.000000000          0.008264463
## 152    0.000000000          0.016835017      0.013468013          0.003367003
## 153    0.000000000          0.000000000      0.285714286          0.000000000
## 154    0.014084507          0.000000000      0.084507042          0.000000000
## 155    0.029940120          0.065868263      0.041916168          0.000000000
## 156    0.000000000          0.000000000      0.151515152          0.000000000
## 157    0.178571429          0.000000000      0.107142857          0.000000000
## 158    0.088235294          0.000000000      0.014705882          0.000000000
## 159    0.125000000          0.000000000      0.000000000          0.000000000
## 160    0.013289037          0.003322259      0.019933555          0.006644518
## 161    0.000000000          0.000000000      0.250000000          0.000000000
## 162    0.000000000          0.000000000      0.166666667          0.000000000
## 163    0.009950249          0.000000000      0.054726368          0.000000000
## 164    0.041666667          0.023809524      0.005952381          0.000000000
## 165    0.000000000          0.000000000      0.074074074          0.000000000
## 166    0.009852217          0.004926108      0.009852217          0.004926108
## 167    0.000000000          0.000000000      0.140000000          0.000000000
## 168    0.019607843          0.000000000      0.026143791          0.000000000
## 169    0.030303030          0.000000000      0.030303030          0.000000000
## 170    0.030303030          0.000000000      0.000000000          0.000000000
## 171    0.011111111          0.000000000      0.027777778          0.000000000
## 172    0.000000000          0.000000000      0.048951049          0.000000000
## 173    0.000000000          0.000000000      0.222222222          0.000000000
## 174    0.000000000          0.000000000      0.000000000          0.000000000
## 175    0.035714286          0.000000000      0.000000000          0.000000000
## 176    0.000000000          0.000000000      0.000000000          0.000000000
```

```
## 177    0.030303030          0.000000000      0.090909091          0.030303030
## 178    0.024390244          0.000000000      0.012195122          0.000000000
## 179    0.056994819          0.000000000      0.031088083          0.005181347
## 180    0.000000000          0.000000000      0.052631579          0.013157895
## 181    0.052631579          0.000000000      0.000000000          0.000000000
## 182    0.047619048          0.000000000      0.095238095          0.000000000
## 183    0.000000000          0.009803922      0.009803922          0.009803922
## 184    0.173333333          0.000000000      0.040000000          0.000000000
## 185    0.000000000          0.000000000      0.068965517          0.000000000
## 186    0.025862069          0.172413793      0.008620690          0.000000000
## 187    0.053763441          0.000000000      0.000000000          0.000000000
## 188    0.025641026          0.115384615      0.000000000          0.000000000
## 189    0.243902439          0.000000000      0.024390244          0.000000000
## 190    0.018518519          0.018518519      0.046296296          0.000000000
## 191    0.025316456          0.012658228      0.025316456          0.000000000
## 192    0.000000000          0.000000000      0.148148148          0.000000000
## 193    0.024390244          0.000000000      0.000000000          0.000000000
## 194    0.000000000          0.000000000      0.206896552          0.000000000
## 195    0.057471264          0.000000000      0.068965517          0.000000000
## 196    0.000000000          0.000000000      0.047619048          0.000000000
## 197    0.020833333          0.000000000      0.062500000          0.000000000
## 198    0.043956044          0.000000000      0.010989011          0.000000000
## 199    0.000000000          0.000000000      0.013698630          0.041095890
## 200    0.000000000          0.015772871      0.006309148          0.000000000
## 201    0.153846154          0.000000000      0.000000000          0.000000000
## 202    0.000000000          0.000000000      0.111111111          0.000000000
## 203    0.034682081          0.000000000      0.017341040          0.000000000
## 204    0.000000000          0.000000000      0.089552239          0.000000000
## 205    0.000000000          0.041666667      0.000000000          0.000000000
## 206    0.072625698          0.016759777      0.016759777          0.000000000
## 207    0.030303030          0.012121212      0.048484848          0.006060606
## 208    0.050000000          0.000000000      0.125000000          0.000000000
## 209    0.000000000          0.000000000      0.018181818          0.000000000
## 210    0.116279070          0.069767442      0.069767442          0.000000000
## 211    0.060975610          0.000000000      0.048780488          0.012195122
## 212    0.000000000          0.000000000      0.022346369          0.000000000
## 213    0.078212291          0.000000000      0.033519553          0.005586592
## 214    0.028571429          0.000000000      0.114285714          0.000000000
## 215    0.000000000          0.000000000      0.025641026          0.000000000
## 216    0.016393443          0.000000000      0.032786885          0.000000000
## 217    0.008620690          0.000000000      0.034482759          0.025862069
## 218    0.011627907          0.011627907      0.058139535          0.000000000
## 219    0.000000000          0.037735849      0.056603774          0.000000000
## 220    0.000000000          0.000000000      0.078947368          0.000000000
## 221    0.095238095          0.000000000      0.000000000          0.000000000
## 222    0.042553191          0.042553191      0.021276596          0.000000000
## 223    0.000000000          0.000000000      0.047619048          0.000000000
## 224    0.000000000          0.000000000      0.129032258          0.000000000
## 225    0.000000000          0.000000000      0.062500000          0.000000000
## 226    0.000000000          0.032258065      0.129032258          0.000000000
## 227    0.093750000          0.000000000      0.031250000          0.000000000
## 228    0.009259259          0.041666667      0.032407407          0.000000000
## 229    0.012658228          0.050632911      0.101265823          0.000000000
## 230    0.024875622          0.000000000      0.014925373          0.004975124
```

```
## 231    0.012048193          0.024096386      0.024096386          0.000000000
## 232    0.021276596          0.021276596      0.000000000          0.000000000
## 233    0.041860465          0.000000000      0.013953488          0.000000000
## 234    0.200000000          0.000000000      0.000000000          0.000000000
## 235    0.063157895          0.000000000      0.010526316          0.005263158
## 236    0.000000000          0.000000000      0.157894737          0.000000000
## 237    0.025000000          0.037500000      0.037500000          0.012500000
## 238    0.054054054          0.013513514      0.148648649          0.000000000
## 239    0.000000000          0.000000000      0.000000000          0.000000000
## 240    0.000000000          0.051094891      0.029197080          0.000000000
## 241    0.083333333          0.000000000      0.016666667          0.000000000
## 242    0.061433447          0.000000000      0.013651877          0.003412969
## 243    0.081081081          0.000000000      0.162162162          0.000000000
## 244    0.000000000          0.000000000      0.185185185          0.000000000
## 245    0.006920415          0.000000000      0.003460208          0.000000000
## 246    0.083333333          0.000000000      0.041666667          0.000000000
## 247    0.000000000          0.000000000      0.052631579          0.000000000
## 248    0.000000000          0.000000000      0.076923077          0.000000000
## 249    0.047619048          0.000000000      0.053571429          0.000000000
## 250    0.012165450          0.000000000      0.000000000          0.001216545
## 251    0.118644068          0.000000000      0.000000000          0.033898305
## 252    0.012820513          0.000000000      0.051282051          0.038461538
## 253    0.000000000          0.000000000      0.090909091          0.000000000
## 254    0.000000000          0.000000000      0.023923445          0.000000000
##     greenred_wavelength notgreennotred_wavelength noobserved_wavelength
## 1           0.010526316              0.010526316          0.063157895
## 2           0.031250000              0.000000000          0.031250000
## 3           0.000000000              0.000000000          0.058823529
## 4           0.000000000              0.054794521          0.102739726
## 5           0.000000000              0.000000000          0.088888889
## 6           0.017543860              0.017543860          0.052631579
## 7           0.005747126              0.000000000          0.022988506
## 8           0.004784689              0.014354067          0.014354067
## 9           0.000000000              0.000000000          0.250000000
## 10          0.000000000              0.041095890          0.047945205
## 11          0.000000000              0.000000000          0.086956522
## 12          0.000000000              0.000000000          0.277777778
## 13          0.015686275              0.003921569          0.058823529
## 14          0.057692308              0.076923077          0.115384615
## 15          0.000000000              0.006849315          0.013698630
## 16          0.000000000              0.000000000          0.140000000
## 17          0.016759777              0.005586592          0.039106145
## 18          0.027777778              0.027777778          0.166666667
## 19          0.206896552              0.000000000          0.034482759
## 20          0.000000000              0.050000000          0.150000000
## 21          0.000000000              0.032608696          0.032608696
## 22          0.000000000              0.044247788          0.079646018
## 23          0.033333333              0.000000000          0.100000000
## 24          0.051282051              0.000000000          0.102564103
## 25          0.027027027              0.081081081          0.040540541
## 26          0.001406470              0.000000000          0.002812940
## 27          0.004608295              0.009216590          0.041474654
## 28          0.053571429              0.035714286          0.107142857
## 29          0.006756757              0.006756757          0.040540541
```

```
## 30          0.025641026          0.000000000          0.076923077
## 31          0.009771987          0.003257329          0.019543974
## 32          0.030303030          0.000000000          0.121212121
## 33          0.030303030          0.030303030          0.090909091
## 34          0.000000000          0.000000000          0.175438596
## 35          0.000000000          0.000000000          0.200000000
## 36          0.000000000          0.030303030          0.090909091
## 37          0.000000000          0.000000000          0.062500000
## 38          0.000000000          0.000000000          0.036585366
## 39          0.009708738          0.009708738          0.009708738
## 40          0.017543860          0.052631579          0.017543860
## 41          0.012820513          0.000000000          0.115384615
## 42          0.005464481          0.000000000          0.008196721
## 43          0.000000000          0.028985507          0.072463768
## 44          0.012820513          0.000000000          0.038461538
## 45          0.000000000          0.000000000          0.097560976
## 46          0.000000000          0.062500000          0.050000000
## 47          0.152542373          0.033898305          0.033898305
## 48          0.105263158          0.184210526          0.052631579
## 49          0.000000000          0.155555556          0.022222222
## 50          0.000000000          0.000000000          0.122807018
## 51          0.021276596          0.000000000          0.148936170
## 52          0.019047619          0.057142857          0.085714286
## 53          0.022222222          0.088888889          0.066666667
## 54          0.000000000          0.000000000          0.109375000
## 55          0.000000000          0.000000000          0.108695652
## 56          0.038461538          0.108974359          0.108974359
## 57          0.046357616          0.205298013          0.026490066
## 58          0.000000000          0.000000000          0.130434783
## 59          0.011363636          0.011363636          0.011363636
## 60          0.016129032          0.000000000          0.056451613
## 61          0.060606061          0.030303030          0.060606061
## 62          0.037735849          0.018867925          0.056603774
## 63          0.022222222          0.022222222          0.066666667
## 64          0.046511628          0.023255814          0.023255814
## 65          0.000000000          0.082474227          0.103092784
## 66          0.022222222          0.000000000          0.044444444
## 67          0.000000000          0.022727273          0.011363636
## 68          0.010101010          0.020202020          0.020202020
## 69          0.045454545          0.000000000          0.272727273
## 70          0.000000000          0.000000000          0.074074074
## 71          0.200000000          0.000000000          0.050000000
## 72          0.000000000          0.006818182          0.009090909
## 73          0.000000000          0.000000000          0.015873016
## 74          0.022222222          0.014814815          0.044444444
## 75          0.060000000          0.040000000          0.120000000
## 76          0.000000000          0.000000000          0.200000000
## 77          0.006289308          0.000000000          0.025157233
## 78          0.037037037          0.000000000          0.037037037
## 79          0.038461538          0.000000000          0.038461538
## 80          0.001754386          0.001754386          0.005263158
## 81          0.035502959          0.005917160          0.023668639
## 82          0.026737968          0.042780749          0.101604278
## 83          0.000000000          0.000000000          0.155555556
```

```
## 84          0.031250000          0.000000000          0.062500000
## 85          0.048192771          0.036144578          0.096385542
## 86          0.019607843          0.000000000          0.019607843
## 87          0.000000000          0.056603774          0.018867925
## 88          0.062500000          0.041666667          0.010416667
## 89          0.018604651          0.000000000          0.009302326
## 90          0.010526316          0.000000000          0.021052632
## 91          0.046511628          0.000000000          0.046511628
## 92          0.096774194          0.000000000          0.129032258
## 93          0.002531646          0.005063291          0.022784810
## 94          0.000000000          0.169811321          0.018867925
## 95          0.043478261          0.043478261          0.086956522
## 96          0.000000000          0.020270270          0.020270270
## 97          0.000000000          0.000000000          0.222222222
## 98          0.165048544          0.009708738          0.077669903
## 99          0.021739130          0.000000000          0.065217391
## 100         0.011235955          0.000000000          0.033707865
## 101         0.000000000          0.006756757          0.013513514
## 102         0.000000000          0.000000000          0.032085561
## 103         0.005376344          0.010752688          0.069892473
## 104         0.041666667          0.041666667          0.166666667
## 105         0.004444444          0.008888889          0.160000000
## 106         0.007692308          0.092307692          0.038461538
## 107         0.000000000          0.013157895          0.065789474
## 108         0.025641026          0.000000000          0.076923077
## 109         0.033333333          0.000000000          0.033333333
## 110         0.029629630          0.000000000          0.103703704
## 111         0.000000000          0.003831418          0.022988506
## 112         0.000000000          0.007407407          0.014814815
## 113         0.030303030          0.000000000          0.181818182
## 114         0.026315789          0.013157895          0.092105263
## 115         0.000000000          0.037037037          0.111111111
## 116         0.058823529          0.000000000          0.078431373
## 117         0.008474576          0.033898305          0.025423729
## 118         0.000000000          0.000000000          0.181818182
## 119         0.000000000          0.000000000          0.054794521
## 120         0.007092199          0.007092199          0.035460993
## 121         0.000000000          0.000000000          0.055837563
## 122         0.015625000          0.046875000          0.046875000
## 123         0.027777778          0.013888889          0.013888889
## 124         0.058823529          0.014705882          0.058823529
## 125         0.000000000          0.000000000          0.086956522
## 126         0.013513514          0.121621622          0.027027027
## 127         0.024242424          0.000000000          0.012121212
## 128         0.000000000          0.000000000          0.178571429
## 129         0.006289308          0.050314465          0.031446541
## 130         0.000000000          0.027777778          0.083333333
## 131         0.011764706          0.011764706          0.070588235
## 132         0.085106383          0.042553191          0.042553191
## 133         0.000000000          0.038709677          0.025806452
## 134         0.019480519          0.000000000          0.064935065
## 135         0.045454545          0.045454545          0.000000000
## 136         0.038461538          0.038461538          0.153846154
## 137         0.027027027          0.000000000          0.081081081
```

```
## 138        0.000000000          0.009756098          0.014634146
## 139        0.000000000          0.000000000          0.071428571
## 140        0.069767442          0.000000000          0.116279070
## 141        0.027027027          0.081081081          0.040540541
## 142        0.000000000          0.000000000          0.042654028
## 143        0.000000000          0.142857143          0.071428571
## 144        0.022222222          0.000000000          0.111111111
## 145        0.012987013          0.000000000          0.194805195
## 146        0.000000000          0.020000000          0.006666667
## 147        0.018181818          0.054545455          0.000000000
## 148        0.013333333          0.000000000          0.080000000
## 149        0.018518519          0.000000000          0.074074074
## 150        0.027027027          0.081081081          0.135135135
## 151        0.024793388          0.008264463          0.008264463
## 152        0.020202020          0.040404040          0.030303030
## 153        0.000000000          0.000000000          0.190476190
## 154        0.028169014          0.000000000          0.028169014
## 155        0.005988024          0.005988024          0.035928144
## 156        0.000000000          0.000000000          0.181818182
## 157        0.035714286          0.000000000          0.107142857
## 158        0.014705882          0.000000000          0.058823529
## 159        0.062500000          0.000000000          0.187500000
## 160        0.009966777          0.039867110          0.016611296
## 161        0.000000000          0.025000000          0.075000000
## 162        0.000000000          0.000000000          0.444444444
## 163        0.000000000          0.000000000          0.064676617
## 164        0.023809524          0.000000000          0.017857143
## 165        0.000000000          0.000000000          0.222222222
## 166        0.009852217          0.019704433          0.034482759
## 167        0.000000000          0.000000000          0.200000000
## 168        0.013071895          0.000000000          0.026143791
## 169        0.030303030          0.000000000          0.272727273
## 170        0.196969697          0.090909091          0.015151515
## 171        0.000000000          0.011111111          0.027777778
## 172        0.000000000          0.006993007          0.062937063
## 173        0.000000000          0.000000000          0.055555556
## 174        0.000000000          0.125000000          0.093750000
## 175        0.000000000          0.035714286          0.071428571
## 176        0.166666667          0.000000000          0.166666667
## 177        0.000000000          0.030303030          0.090909091
## 178        0.036585366          0.000000000          0.060975610
## 179        0.020725389          0.005181347          0.041450777
## 180        0.013157895          0.026315789          0.039473684
## 181        0.000000000          0.052631579          0.105263158
## 182        0.047619048          0.000000000          0.190476190
## 183        0.029411765          0.039215686          0.039215686
## 184        0.080000000          0.000000000          0.013333333
## 185        0.000000000          0.000000000          0.137931034
## 186        0.008620690          0.043103448          0.008620690
## 187        0.021505376          0.010752688          0.021505376
## 188        0.019230769          0.019230769          0.012820513
## 189        0.048780488          0.000000000          0.073170732
## 190        0.000000000          0.037037037          0.027777778
## 191        0.113924051          0.025316456          0.063291139
```

```
## 192        0.000000000         0.037037037         0.259259259
## 193        0.170731707         0.024390244         0.024390244
## 194        0.000000000         0.000000000         0.103448276
## 195        0.011494253         0.000000000         0.091954023
## 196        0.000000000         0.000000000         0.095238095
## 197        0.020833333         0.000000000         0.125000000
## 198        0.032967033         0.010989011         0.043956044
## 199        0.054794521         0.041095890         0.000000000
## 200        0.000000000         0.012618297         0.037854890
## 201        0.038461538         0.000000000         0.115384615
## 202        0.000000000         0.000000000         0.333333333
## 203        0.011560694         0.000000000         0.023121387
## 204        0.000000000         0.000000000         0.134328358
## 205        0.000000000         0.125000000         0.083333333
## 206        0.033519553         0.016759777         0.033519553
## 207        0.000000000         0.012121212         0.030303030
## 208        0.025000000         0.000000000         0.050000000
## 209        0.000000000         0.090909091         0.109090909
## 210        0.023255814         0.046511628         0.093023256
## 211        0.000000000         0.060975610         0.048780488
## 212        0.005586592         0.005586592         0.083798883
## 213        0.005586592         0.011173184         0.044692737
## 214        0.000000000         0.057142857         0.228571429
## 215        0.025641026         0.000000000         0.025641026
## 216        0.016393443         0.295081967         0.081967213
## 217        0.000000000         0.008620690         0.025862069
## 218        0.011627907         0.011627907         0.034883721
## 219        0.000000000         0.018867925         0.056603774
## 220        0.000000000         0.026315789         0.078947368
## 221        0.000000000         0.000000000         0.190476190
## 222        0.021276596         0.000000000         0.042553191
## 223        0.047619048         0.095238095         0.142857143
## 224        0.000000000         0.000000000         0.161290323
## 225        0.000000000         0.000000000         0.072916667
## 226        0.000000000         0.032258065         0.129032258
## 227        0.031250000         0.000000000         0.125000000
## 228        0.000000000         0.013888889         0.069444444
## 229        0.000000000         0.012658228         0.037974684
## 230        0.000000000         0.009950249         0.014925373
## 231        0.012048193         0.000000000         0.096385542
## 232        0.021276596         0.000000000         0.021276596
## 233        0.004651163         0.000000000         0.013953488
## 234        0.080000000         0.000000000         0.080000000
## 235        0.005263158         0.010526316         0.005263158
## 236        0.000000000         0.000000000         0.263157895
## 237        0.025000000         0.012500000         0.012500000
## 238        0.013513514         0.040540541         0.040540541
## 239        0.076923077         0.115384615         0.038461538
## 240        0.007299270         0.065693431         0.065693431
## 241        0.016666667         0.000000000         0.066666667
## 242        0.006825939         0.006825939         0.010238908
## 243        0.027027027         0.000000000         0.081081081
## 244        0.000000000         0.000000000         0.129629630
## 245        0.006920415         0.003460208         0.038062284
```

```
## 246         0.000000000              0.041666667           0.041666667
## 247         0.000000000              0.000000000           0.052631579
## 248         0.000000000              0.000000000           0.538461538
## 249         0.017857143              0.011904762           0.017857143
## 250         0.002433090              0.000000000           0.001216545
## 251         0.000000000              0.016949153           0.033898305
## 252         0.025641026              0.000000000           0.179487179
## 253         0.000000000              0.000000000           0.454545455
## 254         0.002392344              0.007177033           0.011961722
##     greengreen_solution greenred_solution notgreennotred_solution
## 1           0.021052632       0.031578947             0.021052632
## 2           0.000000000       0.000000000             0.000000000
## 3           0.000000000       0.000000000             0.000000000
## 4           0.000000000       0.000000000             0.020547945
## 5           0.000000000       0.000000000             0.000000000
## 6           0.017543860       0.087719298             0.000000000
## 7           0.000000000       0.000000000             0.000000000
## 8           0.014354067       0.033492823             0.009569378
## 9           0.000000000       0.000000000             0.000000000
## 10          0.000000000       0.013698630             0.027397260
## 11          0.000000000       0.000000000             0.000000000
## 12          0.000000000       0.000000000             0.000000000
## 13          0.000000000       0.003921569             0.000000000
## 14          0.000000000       0.038461538             0.076923077
## 15          0.000000000       0.034246575             0.006849315
## 16          0.000000000       0.000000000             0.000000000
## 17          0.011173184       0.027932961             0.000000000
## 18          0.000000000       0.027777778             0.000000000
## 19          0.000000000       0.000000000             0.000000000
## 20          0.000000000       0.300000000             0.050000000
## 21          0.021739130       0.076086957             0.000000000
## 22          0.008849558       0.000000000             0.000000000
## 23          0.000000000       0.066666667             0.033333333
## 24          0.000000000       0.000000000             0.000000000
## 25          0.000000000       0.013513514             0.027027027
## 26          0.000000000       0.000000000             0.000000000
## 27          0.000000000       0.004608295             0.000000000
## 28          0.017857143       0.107142857             0.017857143
## 29          0.006756757       0.033783784             0.027027027
## 30          0.000000000       0.000000000             0.000000000
## 31          0.003257329       0.003257329             0.003257329
## 32          0.000000000       0.000000000             0.000000000
## 33          0.030303030       0.060606061             0.000000000
## 34          0.000000000       0.000000000             0.000000000
## 35          0.000000000       0.000000000             0.000000000
## 36          0.000000000       0.060606061             0.030303030
## 37          0.000000000       0.000000000             0.000000000
## 38          0.000000000       0.000000000             0.000000000
## 39          0.009708738       0.019417476             0.000000000
## 40          0.000000000       0.017543860             0.017543860
## 41          0.000000000       0.000000000             0.000000000
## 42          0.000000000       0.000000000             0.000000000
## 43          0.000000000       0.072463768             0.000000000
## 44          0.000000000       0.000000000             0.025641026
```

```
## 45          0.000000000       0.000000000           0.000000000
## 46          0.012500000       0.000000000           0.012500000
## 47          0.000000000       0.033898305           0.016949153
## 48          0.000000000       0.000000000           0.026315789
## 49          0.000000000       0.000000000           0.000000000
## 50          0.000000000       0.000000000           0.000000000
## 51          0.000000000       0.000000000           0.000000000
## 52          0.019047619       0.047619048           0.028571429
## 53          0.000000000       0.022222222           0.022222222
## 54          0.000000000       0.000000000           0.000000000
## 55          0.000000000       0.021739130           0.000000000
## 56          0.012820513       0.025641026           0.019230769
## 57          0.013245033       0.052980132           0.086092715
## 58          0.000000000       0.000000000           0.000000000
## 59          0.000000000       0.026515152           0.060606061
## 60          0.000000000       0.000000000           0.000000000
## 61          0.030303030       0.030303030           0.000000000
## 62          0.018867925       0.037735849           0.000000000
## 63          0.000000000       0.088888889           0.000000000
## 64          0.000000000       0.023255814           0.023255814
## 65          0.000000000       0.000000000           0.000000000
## 66          0.000000000       0.022222222           0.000000000
## 67          0.005681818       0.022727273           0.022727273
## 68          0.010101010       0.060606061           0.030303030
## 69          0.000000000       0.000000000           0.000000000
## 70          0.000000000       0.000000000           0.000000000
## 71          0.000000000       0.150000000           0.000000000
## 72          0.004545455       0.006818182           0.000000000
## 73          0.000000000       0.010582011           0.021164021
## 74          0.014814815       0.037037037           0.000000000
## 75          0.000000000       0.040000000           0.020000000
## 76          0.000000000       0.000000000           0.000000000
## 77          0.012578616       0.037735849           0.000000000
## 78          0.000000000       0.000000000           0.000000000
## 79          0.000000000       0.038461538           0.000000000
## 80          0.001754386       0.008771930           0.000000000
## 81          0.000000000       0.088757396           0.076923077
## 82          0.000000000       0.032085561           0.101604278
## 83          0.000000000       0.000000000           0.000000000
## 84          0.000000000       0.000000000           0.000000000
## 85          0.012048193       0.060240964           0.048192771
## 86          0.000000000       0.000000000           0.000000000
## 87          0.000000000       0.018867925           0.037735849
## 88          0.010416667       0.031250000           0.010416667
## 89          0.000000000       0.027906977           0.004651163
## 90          0.000000000       0.000000000           0.000000000
## 91          0.000000000       0.000000000           0.000000000
## 92          0.000000000       0.161290323           0.032258065
## 93          0.000000000       0.007594937           0.015189873
## 94          0.000000000       0.000000000           0.037735849
## 95          0.000000000       0.043478261           0.000000000
## 96          0.000000000       0.000000000           0.000000000
## 97          0.000000000       0.000000000           0.000000000
## 98          0.009708738       0.009708738           0.000000000
```

```
## 99          0.000000000       0.000000000           0.000000000
## 100         0.000000000       0.000000000           0.000000000
## 101         0.000000000       0.013513514           0.000000000
## 102         0.000000000       0.000000000           0.000000000
## 103         0.005376344       0.010752688           0.000000000
## 104         0.013888889       0.027777778           0.055555556
## 105         0.000000000       0.000000000           0.004444444
## 106         0.007692308       0.076923077           0.092307692
## 107         0.000000000       0.000000000           0.013157895
## 108         0.000000000       0.128205128           0.076923077
## 109         0.000000000       0.000000000           0.000000000
## 110         0.000000000       0.029629630           0.029629630
## 111         0.000000000       0.000000000           0.000000000
## 112         0.000000000       0.014814815           0.007407407
## 113         0.000000000       0.060606061           0.000000000
## 114         0.013157895       0.065789474           0.000000000
## 115         0.000000000       0.037037037           0.000000000
## 116         0.000000000       0.000000000           0.000000000
## 117         0.008474576       0.042372881           0.093220339
## 118         0.000000000       0.000000000           0.000000000
## 119         0.000000000       0.000000000           0.000000000
## 120         0.007092199       0.014184397           0.000000000
## 121         0.000000000       0.000000000           0.000000000
## 122         0.046875000       0.062500000           0.031250000
## 123         0.000000000       0.069444444           0.083333333
## 124         0.014705882       0.132352941           0.044117647
## 125         0.000000000       0.000000000           0.000000000
## 126         0.027027027       0.081081081           0.108108108
## 127         0.000000000       0.000000000           0.000000000
## 128         0.000000000       0.000000000           0.000000000
## 129         0.006289308       0.062893082           0.062893082
## 130         0.027777778       0.027777778           0.000000000
## 131         0.000000000       0.011764706           0.000000000
## 132         0.000000000       0.170212766           0.106382979
## 133         0.006451613       0.064516129           0.187096774
## 134         0.000000000       0.006493506           0.000000000
## 135         0.000000000       0.045454545           0.181818182
## 136         0.038461538       0.038461538           0.000000000
## 137         0.000000000       0.000000000           0.000000000
## 138         0.009756098       0.024390244           0.000000000
## 139         0.000000000       0.000000000           0.000000000
## 140         0.000000000       0.069767442           0.023255814
## 141         0.027027027       0.013513514           0.027027027
## 142         0.000000000       0.000000000           0.000000000
## 143         0.035714286       0.107142857           0.000000000
## 144         0.000000000       0.000000000           0.000000000
## 145         0.012987013       0.000000000           0.000000000
## 146         0.006666667       0.036666667           0.023333333
## 147         0.036363636       0.018181818           0.000000000
## 148         0.000000000       0.000000000           0.000000000
## 149         0.000000000       0.000000000           0.000000000
## 150         0.000000000       0.027027027           0.000000000
## 151         0.008264463       0.090909091           0.008264463
## 152         0.016835017       0.107744108           0.023569024
```

```
## 153        0.000000000       0.000000000           0.000000000
## 154        0.000000000       0.000000000           0.000000000
## 155        0.011976048       0.029940120           0.023952096
## 156        0.000000000       0.000000000           0.000000000
## 157        0.000000000       0.000000000           0.000000000
## 158        0.000000000       0.000000000           0.000000000
## 159        0.000000000       0.062500000           0.000000000
## 160        0.013289037       0.043189369           0.033222591
## 161        0.000000000       0.000000000           0.000000000
## 162        0.000000000       0.000000000           0.000000000
## 163        0.000000000       0.000000000           0.000000000
## 164        0.000000000       0.029761905           0.011904762
## 165        0.000000000       0.000000000           0.000000000
## 166        0.029556650       0.073891626           0.044334975
## 167        0.000000000       0.000000000           0.000000000
## 168        0.000000000       0.006535948           0.000000000
## 169        0.000000000       0.000000000           0.000000000
## 170        0.015151515       0.136363636           0.121212121
## 171        0.000000000       0.005555556           0.000000000
## 172        0.000000000       0.000000000           0.000000000
## 173        0.000000000       0.000000000           0.000000000
## 174        0.000000000       0.125000000           0.250000000
## 175        0.035714286       0.107142857           0.000000000
## 176        0.000000000       0.055555556           0.000000000
## 177        0.000000000       0.030303030           0.000000000
## 178        0.024390244       0.000000000           0.000000000
## 179        0.000000000       0.041450777           0.010362694
## 180        0.013157895       0.026315789           0.000000000
## 181        0.000000000       0.000000000           0.000000000
## 182        0.000000000       0.000000000           0.000000000
## 183        0.009803922       0.039215686           0.029411765
## 184        0.000000000       0.066666667           0.000000000
## 185        0.000000000       0.000000000           0.000000000
## 186        0.008620690       0.034482759           0.060344828
## 187        0.032258065       0.043010753           0.021505376
## 188        0.025641026       0.044871795           0.032051282
## 189        0.000000000       0.048780488           0.024390244
## 190        0.000000000       0.055555556           0.037037037
## 191        0.000000000       0.025316456           0.075949367
## 192        0.000000000       0.000000000           0.000000000
## 193        0.000000000       0.097560976           0.024390244
## 194        0.000000000       0.000000000           0.000000000
## 195        0.000000000       0.000000000           0.011494253
## 196        0.000000000       0.000000000           0.000000000
## 197        0.000000000       0.000000000           0.000000000
## 198        0.010989011       0.010989011           0.000000000
## 199        0.013698630       0.013698630           0.000000000
## 200        0.000000000       0.022082019           0.044164038
## 201        0.000000000       0.000000000           0.000000000
## 202        0.000000000       0.000000000           0.000000000
## 203        0.005780347       0.023121387           0.017341040
## 204        0.000000000       0.000000000           0.000000000
## 205        0.000000000       0.041666667           0.000000000
## 206        0.005586592       0.061452514           0.055865922
```

```
## 207         0.012121212       0.018181818             0.006060606
## 208         0.000000000       0.000000000             0.000000000
## 209         0.000000000       0.018181818             0.054545455
## 210         0.000000000       0.000000000             0.046511628
## 211         0.012195122       0.121951220             0.000000000
## 212         0.005586592       0.011173184             0.000000000
## 213         0.005586592       0.055865922             0.067039106
## 214         0.000000000       0.028571429             0.028571429
## 215         0.000000000       0.051282051             0.000000000
## 216         0.000000000       0.032786885             0.049180328
## 217         0.008620690       0.008620690             0.000000000
## 218         0.011627907       0.034883721             0.000000000
## 219         0.000000000       0.150943396             0.113207547
## 220         0.000000000       0.000000000             0.000000000
## 221         0.000000000       0.071428571             0.000000000
## 222         0.000000000       0.085106383             0.021276596
## 223         0.000000000       0.142857143             0.000000000
## 224         0.000000000       0.000000000             0.000000000
## 225         0.000000000       0.000000000             0.000000000
## 226         0.000000000       0.032258065             0.000000000
## 227         0.000000000       0.031250000             0.031250000
## 228         0.000000000       0.018518519             0.037037037
## 229         0.000000000       0.012658228             0.012658228
## 230         0.004975124       0.009950249             0.000000000
## 231         0.000000000       0.000000000             0.012048193
## 232         0.000000000       0.148936170             0.191489362
## 233         0.000000000       0.000000000             0.000000000
## 234         0.000000000       0.060000000             0.060000000
## 235         0.010526316       0.047368421             0.005263158
## 236         0.000000000       0.000000000             0.000000000
## 237         0.000000000       0.037500000             0.000000000
## 238         0.000000000       0.094594595             0.000000000
## 239         0.000000000       0.038461538             0.000000000
## 240         0.000000000       0.021897810             0.094890511
## 241         0.000000000       0.000000000             0.000000000
## 242         0.006825939       0.044368601             0.017064846
## 243         0.000000000       0.000000000             0.000000000
## 244         0.000000000       0.000000000             0.000000000
## 245         0.000000000       0.006920415             0.003460208
## 246         0.000000000       0.041666667             0.000000000
## 247         0.000000000       0.000000000             0.000000000
## 248         0.000000000       0.000000000             0.000000000
## 249         0.000000000       0.005952381             0.005952381
## 250         0.000000000       0.009732360             0.000000000
## 251         0.000000000       0.033898305             0.016949153
## 252         0.000000000       0.000000000             0.000000000
## 253         0.000000000       0.000000000             0.000000000
## 254         0.000000000       0.016746411             0.043062201
##     noobserved_solution concentrationlab greengreen_pdf greenred_pdf
## 1           0.010526316      0.000000000    0.042105263  0.052631579
## 2           0.109375000      0.000000000    0.000000000  0.015625000
## 3           0.049019608      0.000000000    0.000000000  0.009803922
## 4           0.191780822      0.000000000    0.000000000  0.000000000
## 5           0.044444444      0.000000000    0.000000000  0.044444444
```

```
## 6          0.000000000    0.000000000    0.017543860  0.035087719
## 7          0.000000000    0.000000000    0.000000000  0.017241379
## 8          0.004784689    0.000000000    0.023923445  0.019138756
## 9          0.000000000    0.000000000    0.000000000  0.000000000
## 10         0.061643836    0.000000000    0.000000000  0.006849315
## 11         0.086956522    0.000000000    0.000000000  0.000000000
## 12         0.055555556    0.000000000    0.000000000  0.000000000
## 13         0.129411765    0.003921569    0.015686275  0.035294118
## 14         0.038461538    0.000000000    0.000000000  0.000000000
## 15         0.027397260    0.000000000    0.000000000  0.020547945
## 16         0.220000000    0.000000000    0.000000000  0.000000000
## 17         0.050279330    0.000000000    0.027932961  0.033519553
## 18         0.000000000    0.000000000    0.000000000  0.055555556
## 19         0.000000000    0.000000000    0.000000000  0.068965517
## 20         0.000000000    0.000000000    0.000000000  0.000000000
## 21         0.010869565    0.000000000    0.032608696  0.032608696
## 22         0.230088496    0.000000000    0.000000000  0.000000000
## 23         0.000000000    0.000000000    0.000000000  0.000000000
## 24         0.000000000    0.000000000    0.000000000  0.051282051
## 25         0.000000000    0.000000000    0.000000000  0.000000000
## 26         0.002812940    0.000000000    0.000000000  0.000000000
## 27         0.036866359    0.000000000    0.004608295  0.013824885
## 28         0.000000000    0.000000000    0.017857143  0.089285714
## 29         0.000000000    0.000000000    0.033783784  0.101351351
## 30         0.051282051    0.000000000    0.000000000  0.153846154
## 31         0.009771987    0.000000000    0.003257329  0.006514658
## 32         0.000000000    0.000000000    0.000000000  0.060606061
## 33         0.000000000    0.000000000    0.000000000  0.030303030
## 34         0.017543860    0.000000000    0.000000000  0.000000000
## 35         0.150000000    0.000000000    0.000000000  0.000000000
## 36         0.000000000    0.000000000    0.000000000  0.121212121
## 37         0.046875000    0.000000000    0.015625000  0.000000000
## 38         0.109756098    0.000000000    0.000000000  0.000000000
## 39         0.009708738    0.000000000    0.048543689  0.087378641
## 40         0.000000000    0.000000000    0.017543860  0.087719298
## 41         0.089743590    0.000000000    0.000000000  0.000000000
## 42         0.002732240    0.000000000    0.000000000  0.005464481
## 43         0.086956522    0.000000000    0.000000000  0.000000000
## 44         0.102564103    0.000000000    0.000000000  0.038461538
## 45         0.268292683    0.000000000    0.000000000  0.000000000
## 46         0.112500000    0.000000000    0.000000000  0.000000000
## 47         0.000000000    0.000000000    0.000000000  0.118644068
## 48         0.000000000    0.000000000    0.000000000  0.052631579
## 49         0.022222222    0.000000000    0.000000000  0.000000000
## 50         0.035087719    0.000000000    0.000000000  0.000000000
## 51         0.063829787    0.000000000    0.000000000  0.000000000
## 52         0.057142857    0.000000000    0.019047619  0.038095238
## 53         0.022222222    0.000000000    0.022222222  0.000000000
## 54         0.171875000    0.000000000    0.000000000  0.000000000
## 55         0.043478261    0.000000000    0.000000000  0.021739130
## 56         0.025641026    0.000000000    0.000000000  0.000000000
## 57         0.000000000    0.000000000    0.000000000  0.000000000
## 58         0.130434783    0.000000000    0.000000000  0.000000000
## 59         0.000000000    0.000000000    0.000000000  0.015151515
```

```
## 60          0.000000000    0.000000000    0.000000000  0.000000000
## 61          0.000000000    0.000000000    0.000000000  0.030303030
## 62          0.000000000    0.000000000    0.037735849  0.094339623
## 63          0.000000000    0.000000000    0.044444444  0.111111111
## 64          0.000000000    0.000000000    0.000000000  0.000000000
## 65          0.082474227    0.000000000    0.000000000  0.000000000
## 66          0.000000000    0.000000000    0.000000000  0.133333333
## 67          0.011363636    0.000000000    0.005681818  0.011363636
## 68          0.000000000    0.000000000    0.050505051  0.080808081
## 69          0.000000000    0.000000000    0.000000000  0.090909091
## 70          0.129629630    0.000000000    0.000000000  0.000000000
## 71          0.000000000    0.000000000    0.000000000  0.150000000
## 72          0.013636364    0.000000000    0.006818182  0.013636364
## 73          0.005291005    0.000000000    0.000000000  0.000000000
## 74          0.014814815    0.000000000    0.103703704  0.133333333
## 75          0.000000000    0.000000000    0.040000000  0.080000000
## 76          0.000000000    0.000000000    0.000000000  0.000000000
## 77          0.018867925    0.000000000    0.000000000  0.018867925
## 78          0.000000000    0.000000000    0.000000000  0.018518519
## 79          0.000000000    0.000000000    0.000000000  0.105769231
## 80          0.001754386    0.000000000    0.000000000  0.001754386
## 81          0.005917160    0.000000000    0.000000000  0.023668639
## 82          0.021390374    0.000000000    0.000000000  0.000000000
## 83          0.066666667    0.022222222    0.000000000  0.000000000
## 84          0.031250000    0.000000000    0.000000000  0.031250000
## 85          0.036144578    0.000000000    0.012048193  0.096385542
## 86          0.039215686    0.000000000    0.000000000  0.117647059
## 87          0.000000000    0.000000000    0.000000000  0.000000000
## 88          0.000000000    0.000000000    0.031250000  0.093750000
## 89          0.018604651    0.004651163    0.000000000  0.041860465
## 90          0.000000000    0.000000000    0.000000000  0.168421053
## 91          0.000000000    0.000000000    0.000000000  0.023255814
## 92          0.032258065    0.000000000    0.000000000  0.064516129
## 93          0.007594937    0.000000000    0.000000000  0.022784810
## 94          0.018867925    0.000000000    0.000000000  0.000000000
## 95          0.000000000    0.000000000    0.000000000  0.130434783
## 96          0.013513514    0.000000000    0.013513514  0.000000000
## 97          0.027777778    0.000000000    0.000000000  0.000000000
## 98          0.009708738    0.000000000    0.019417476  0.058252427
## 99          0.000000000    0.000000000    0.000000000  0.108695652
## 100         0.000000000    0.000000000    0.000000000  0.000000000
## 101         0.000000000    0.020270270    0.000000000  0.033783784
## 102         0.026737968    0.000000000    0.000000000  0.000000000
## 103         0.048387097    0.000000000    0.005376344  0.016129032
## 104         0.166666667    0.000000000    0.000000000  0.000000000
## 105         0.057777778    0.000000000    0.000000000  0.000000000
## 106         0.000000000    0.000000000    0.007692308  0.069230769
## 107         0.105263158    0.000000000    0.000000000  0.000000000
## 108         0.000000000    0.000000000    0.000000000  0.051282051
## 109         0.000000000    0.000000000    0.000000000  0.166666667
## 110         0.111111111    0.000000000    0.000000000  0.088888889
## 111         0.049808429    0.000000000    0.000000000  0.000000000
## 112         0.051851852    0.000000000    0.000000000  0.007407407
## 113         0.030303030    0.000000000    0.000000000  0.060606061
```

```
## 114        0.000000000     0.000000000    0.013157895  0.078947368
## 115        0.000000000     0.000000000    0.000000000  0.000000000
## 116        0.058823529     0.000000000    0.000000000  0.039215686
## 117        0.042372881     0.000000000    0.016949153  0.110169492
## 118        0.136363636     0.000000000    0.000000000  0.000000000
## 119        0.260273973     0.000000000    0.000000000  0.000000000
## 120        0.007092199     0.000000000    0.007092199  0.063829787
## 121        0.116751269     0.000000000    0.000000000  0.000000000
## 122        0.015625000     0.000000000    0.046875000  0.078125000
## 123        0.000000000     0.000000000    0.000000000  0.027777778
## 124        0.029411765     0.000000000    0.000000000  0.029411765
## 125        0.057971014     0.000000000    0.000000000  0.000000000
## 126        0.054054054     0.000000000    0.000000000  0.040540541
## 127        0.000000000     0.000000000    0.000000000  0.006060606
## 128        0.089285714     0.000000000    0.000000000  0.017857143
## 129        0.025157233     0.000000000    0.006289308  0.025157233
## 130        0.027777778     0.000000000    0.055555556  0.000000000
## 131        0.023529412     0.000000000    0.011764706  0.082352941
## 132        0.000000000     0.000000000    0.000000000  0.000000000
## 133        0.090322581     0.000000000    0.000000000  0.006451613
## 134        0.045454545     0.000000000    0.000000000  0.071428571
## 135        0.000000000     0.000000000    0.000000000  0.000000000
## 136        0.038461538     0.000000000    0.038461538  0.000000000
## 137        0.000000000     0.000000000    0.000000000  0.000000000
## 138        0.004878049     0.000000000    0.014634146  0.014634146
## 139        0.000000000     0.214285714    0.000000000  0.000000000
## 140        0.093023256     0.000000000    0.000000000  0.046511628
## 141        0.000000000     0.000000000    0.040540541  0.081081081
## 142        0.014218009     0.000000000    0.000000000  0.000000000
## 143        0.000000000     0.000000000    0.035714286  0.071428571
## 144        0.022222222     0.000000000    0.000000000  0.044444444
## 145        0.038961039     0.000000000    0.012987013  0.012987013
## 146        0.006666667     0.000000000    0.000000000  0.003333333
## 147        0.018181818     0.000000000    0.072727273  0.163636364
## 148        0.146666667     0.000000000    0.000000000  0.000000000
## 149        0.018518519     0.000000000    0.000000000  0.018518519
## 150        0.027027027     0.000000000    0.000000000  0.000000000
## 151        0.008264463     0.000000000    0.016528926  0.024793388
## 152        0.016835017     0.000000000    0.030303030  0.043771044
## 153        0.000000000     0.000000000    0.000000000  0.000000000
## 154        0.056338028     0.000000000    0.000000000  0.000000000
## 155        0.023952096     0.000000000    0.005988024  0.023952096
## 156        0.121212121     0.000000000    0.000000000  0.000000000
## 157        0.035714286     0.000000000    0.000000000  0.000000000
## 158        0.073529412     0.000000000    0.000000000  0.044117647
## 159        0.000000000     0.000000000    0.000000000  0.000000000
## 160        0.039867110     0.000000000    0.006644518  0.009966777
## 161        0.150000000     0.000000000    0.000000000  0.000000000
## 162        0.055555556     0.000000000    0.000000000  0.000000000
## 163        0.064676617     0.000000000    0.000000000  0.000000000
## 164        0.000000000     0.000000000    0.000000000  0.047619048
## 165        0.037037037     0.000000000    0.000000000  0.000000000
## 166        0.019704433     0.000000000    0.014778325  0.029556650
## 167        0.080000000     0.000000000    0.000000000  0.000000000
```

```
## 168         0.013071895     0.000000000    0.000000000  0.032679739
## 169         0.000000000     0.000000000    0.000000000  0.000000000
## 170         0.030303030     0.000000000    0.000000000  0.045454545
## 171         0.027777778     0.000000000    0.000000000  0.016666667
## 172         0.020979021     0.000000000    0.000000000  0.000000000
## 173         0.055555556     0.000000000    0.000000000  0.000000000
## 174         0.031250000     0.000000000    0.000000000  0.000000000
## 175         0.000000000     0.000000000    0.035714286  0.178571429
## 176         0.000000000     0.000000000    0.000000000  0.000000000
## 177         0.060606061     0.000000000    0.000000000  0.000000000
## 178         0.012195122     0.000000000    0.012195122  0.012195122
## 179         0.056994819     0.000000000    0.015544041  0.046632124
## 180         0.065789474     0.000000000    0.052631579  0.052631579
## 181         0.000000000     0.000000000    0.000000000  0.000000000
## 182         0.047619048     0.000000000    0.000000000  0.000000000
## 183         0.009803922     0.000000000    0.000000000  0.029411765
## 184         0.013333333     0.000000000    0.000000000  0.093333333
## 185         0.275862069     0.000000000    0.000000000  0.000000000
## 186         0.008620690     0.000000000    0.000000000  0.025862069
## 187         0.010752688     0.000000000    0.021505376  0.053763441
## 188         0.000000000     0.000000000    0.038461538  0.070512821
## 189         0.000000000     0.000000000    0.000000000  0.024390244
## 190         0.027777778     0.000000000    0.000000000  0.055555556
## 191         0.012658228     0.000000000    0.000000000  0.000000000
## 192         0.037037037     0.000000000    0.000000000  0.000000000
## 193         0.000000000     0.000000000    0.000000000  0.121951220
## 194         0.000000000     0.000000000    0.000000000  0.000000000
## 195         0.172413793     0.000000000    0.000000000  0.000000000
## 196         0.047619048     0.000000000    0.000000000  0.000000000
## 197         0.062500000     0.000000000    0.000000000  0.020833333
## 198         0.043956044     0.000000000    0.021978022  0.021978022
## 199         0.000000000     0.000000000    0.136986301  0.027397260
## 200         0.047318612     0.000000000    0.000000000  0.003154574
## 201         0.000000000     0.000000000    0.000000000  0.153846154
## 202         0.000000000     0.000000000    0.000000000  0.000000000
## 203         0.000000000     0.000000000    0.023121387  0.034682081
## 204         0.074626866     0.000000000    0.000000000  0.000000000
## 205         0.041666667     0.000000000    0.000000000  0.000000000
## 206         0.016759777     0.000000000    0.027932961  0.089385475
## 207         0.078787879     0.000000000    0.012121212  0.024242424
## 208         0.000000000     0.000000000    0.000000000  0.050000000
## 209         0.000000000     0.000000000    0.000000000  0.000000000
## 210         0.000000000     0.000000000    0.000000000  0.023255814
## 211         0.000000000     0.000000000    0.012195122  0.097560976
## 212         0.016759777     0.000000000    0.000000000  0.005586592
## 213         0.016759777     0.000000000    0.016759777  0.078212291
## 214         0.085714286     0.000000000    0.000000000  0.028571429
## 215         0.000000000     0.051282051    0.000000000  0.076923077
## 216         0.000000000     0.000000000    0.000000000  0.032786885
## 217         0.017241379     0.000000000    0.000000000  0.008620690
## 218         0.034883721     0.000000000    0.000000000  0.023255814
## 219         0.018867925     0.000000000    0.000000000  0.018867925
## 220         0.315789474     0.000000000    0.000000000  0.000000000
## 221         0.071428571     0.000000000    0.000000000  0.071428571
```

```
## 222         0.021276596      0.000000000    0.000000000  0.063829787
## 223         0.047619048      0.000000000    0.000000000  0.000000000
## 224         0.096774194      0.000000000    0.000000000  0.000000000
## 225         0.020833333      0.000000000    0.000000000  0.000000000
## 226         0.000000000      0.000000000    0.032258065  0.096774194
## 227         0.000000000      0.000000000    0.000000000  0.031250000
## 228         0.060185185      0.000000000    0.000000000  0.000000000
## 229         0.025316456      0.000000000    0.000000000  0.088607595
## 230         0.019900498      0.000000000    0.009950249  0.039800995
## 231         0.120481928      0.000000000    0.000000000  0.000000000
## 232         0.042553191      0.000000000    0.000000000  0.021276596
## 233         0.004651163      0.000000000    0.000000000  0.000000000
## 234         0.000000000      0.000000000    0.000000000  0.080000000
## 235         0.005263158      0.000000000    0.010526316  0.021052632
## 236         0.000000000      0.000000000    0.000000000  0.000000000
## 237         0.000000000      0.000000000    0.000000000  0.037500000
## 238         0.000000000      0.000000000    0.000000000  0.067567568
## 239         0.000000000      0.000000000    0.000000000  0.038461538
## 240         0.043795620      0.000000000    0.000000000  0.000000000
## 241         0.016666667      0.000000000    0.000000000  0.116666667
## 242         0.003412969      0.000000000    0.006825939  0.023890785
## 243         0.000000000      0.000000000    0.000000000  0.000000000
## 244         0.018518519      0.000000000    0.000000000  0.000000000
## 245         0.034602076      0.000000000    0.003460208  0.010380623
## 246         0.000000000      0.000000000    0.000000000  0.083333333
## 247         0.052631579      0.000000000    0.000000000  0.000000000
## 248         0.000000000      0.000000000    0.000000000  0.000000000
## 249         0.000000000      0.000000000    0.000000000  0.035714286
## 250         0.000000000      0.000000000    0.000000000  0.006082725
## 251         0.000000000      0.000000000    0.000000000  0.016949153
## 252         0.128205128      0.000000000    0.012820513  0.000000000
## 253         0.136363636      0.000000000    0.000000000  0.000000000
## 254         0.021531100      0.000000000    0.000000000  0.000000000
##     notgreennotred_pdf noobserved_pdf greengreen_break greenred_break
## 1          0.000000000    0.042105263      0.094736842    0.084210526
## 2          0.000000000    0.281250000      0.000000000    0.031250000
## 3          0.000000000    0.068627451      0.000000000    0.029411765
## 4          0.000000000    0.000000000      0.000000000    0.000000000
## 5          0.000000000    0.133333333      0.000000000    0.133333333
## 6          0.017543860    0.087719298      0.017543860    0.087719298
## 7          0.000000000    0.011494253      0.000000000    0.189655172
## 8          0.004784689    0.019138756      0.133971292    0.062200957
## 9          0.000000000    0.000000000      0.000000000    0.027777778
## 10         0.006849315    0.027397260      0.027397260    0.054794521
## 11         0.000000000    0.086956522      0.000000000    0.000000000
## 12         0.000000000    0.166666667      0.000000000    0.000000000
## 13         0.011764706    0.086274510      0.015686275    0.090196078
## 14         0.000000000    0.000000000      0.000000000    0.057692308
## 15         0.006849315    0.061643836      0.000000000    0.116438356
## 16         0.000000000    0.180000000      0.000000000    0.000000000
## 17         0.005586592    0.044692737      0.072625698    0.067039106
## 18         0.000000000    0.055555556      0.027777778    0.138888889
## 19         0.000000000    0.103448276      0.000000000    0.172413793
## 20         0.050000000    0.100000000      0.000000000    0.100000000
```

```
## 21          0.000000000    0.043478261     0.065217391    0.086956522
## 22          0.035398230    0.035398230     0.008849558    0.000000000
## 23          0.000000000    0.066666667     0.000000000    0.166666667
## 24          0.000000000    0.076923077     0.000000000    0.205128205
## 25          0.013513514    0.054054054     0.000000000    0.054054054
## 26          0.000000000    0.004219409     0.000000000    0.158931083
## 27          0.013824885    0.013824885     0.013824885    0.046082949
## 28          0.035714286    0.107142857     0.000000000    0.053571429
## 29          0.040540541    0.020270270     0.047297297    0.128378378
## 30          0.000000000    0.051282051     0.000000000    0.179487179
## 31          0.003257329    0.009771987     0.019543974    0.127035831
## 32          0.000000000    0.121212121     0.000000000    0.121212121
## 33          0.000000000    0.030303030     0.030303030    0.181818182
## 34          0.000000000    0.087719298     0.000000000    0.035087719
## 35          0.000000000    0.050000000     0.000000000    0.000000000
## 36          0.060606061    0.151515152     0.000000000    0.090909091
## 37          0.000000000    0.062500000     0.000000000    0.000000000
## 38          0.000000000    0.085365854     0.000000000    0.000000000
## 39          0.038834951    0.067961165     0.038834951    0.106796117
## 40          0.000000000    0.017543860     0.000000000    0.157894737
## 41          0.000000000    0.000000000     0.000000000    0.000000000
## 42          0.000000000    0.005464481     0.000000000    0.199453552
## 43          0.000000000    0.028985507     0.000000000    0.101449275
## 44          0.025641026    0.076923077     0.000000000    0.025641026
## 45          0.000000000    0.121951220     0.000000000    0.000000000
## 46          0.025000000    0.112500000     0.037500000    0.000000000
## 47          0.000000000    0.016949153     0.000000000    0.220338983
## 48          0.000000000    0.052631579     0.000000000    0.105263158
## 49          0.000000000    0.000000000     0.000000000    0.000000000
## 50          0.000000000    0.175438596     0.000000000    0.000000000
## 51          0.000000000    0.042553191     0.000000000    0.085106383
## 52          0.028571429    0.066666667     0.038095238    0.028571429
## 53          0.022222222    0.022222222     0.088888889    0.044444444
## 54          0.000000000    0.171875000     0.000000000    0.000000000
## 55          0.000000000    0.065217391     0.000000000    0.065217391
## 56          0.006410256    0.012820513     0.019230769    0.083333333
## 57          0.026490066    0.006622517     0.006622517    0.059602649
## 58          0.000000000    0.086956522     0.000000000    0.043478261
## 59          0.030303030    0.007575758     0.000000000    0.071969697
## 60          0.000000000    0.096774194     0.000000000    0.048387097
## 61          0.000000000    0.060606061     0.151515152    0.090909091
## 62          0.000000000    0.056603774     0.037735849    0.132075472
## 63          0.000000000    0.022222222     0.044444444    0.133333333
## 64          0.023255814    0.023255814     0.000000000    0.116279070
## 65          0.010309278    0.020618557     0.000000000    0.000000000
## 66          0.000000000    0.111111111     0.000000000    0.111111111
## 67          0.005681818    0.017045455     0.045454545    0.028409091
## 68          0.010101010    0.030303030     0.050505051    0.111111111
## 69          0.000000000    0.045454545     0.000000000    0.181818182
## 70          0.000000000    0.092592593     0.000000000    0.000000000
## 71          0.000000000    0.100000000     0.000000000    0.150000000
## 72          0.002272727    0.009090909     0.031818182    0.131818182
## 73          0.005291005    0.010582011     0.000000000    0.031746032
## 74          0.000000000    0.022222222     0.096296296    0.111111111
```

```
## 75        0.020000000   0.060000000   0.000000000   0.140000000
## 76        0.000000000   0.150000000   0.000000000   0.000000000
## 77        0.000000000   0.018867925   0.069182390   0.081761006
## 78        0.000000000   0.092592593   0.000000000   0.148148148
## 79        0.000000000   0.009615385   0.000000000   0.240384615
## 80        0.000000000   0.008771930   0.061403509   0.133333333
## 81        0.005917160   0.017751479   0.000000000   0.130177515
## 82        0.010695187   0.021390374   0.000000000   0.048128342
## 83        0.000000000   0.133333333   0.000000000   0.000000000
## 84        0.000000000   0.156250000   0.000000000   0.062500000
## 85        0.012048193   0.048192771   0.012048193   0.108433735
## 86        0.000000000   0.098039216   0.000000000   0.156862745
## 87        0.132075472   0.000000000   0.000000000   0.037735849
## 88        0.000000000   0.020833333   0.031250000   0.125000000
## 89        0.000000000   0.037209302   0.000000000   0.176744186
## 90        0.000000000   0.084210526   0.000000000   0.168421053
## 91        0.000000000   0.139534884   0.000000000   0.046511628
## 92        0.000000000   0.064516129   0.000000000   0.193548387
## 93        0.005063291   0.020253165   0.000000000   0.131645570
## 94        0.000000000   0.000000000   0.000000000   0.000000000
## 95        0.043478261   0.086956522   0.000000000   0.130434783
## 96        0.000000000   0.054054054   0.006756757   0.000000000
## 97        0.000000000   0.111111111   0.000000000   0.000000000
## 98        0.000000000   0.029126214   0.038834951   0.165048544
## 99        0.000000000   0.043478261   0.000000000   0.173913043
## 100       0.000000000   0.056179775   0.000000000   0.033707865
## 101       0.000000000   0.020270270   0.000000000   0.175675676
## 102       0.000000000   0.026737968   0.000000000   0.005347594
## 103       0.000000000   0.053763441   0.005376344   0.075268817
## 104       0.013888889   0.027777778   0.013888889   0.013888889
## 105       0.004444444   0.097777778   0.000000000   0.000000000
## 106       0.069230769   0.030769231   0.015384615   0.069230769
## 107       0.092105263   0.065789474   0.000000000   0.000000000
## 108       0.000000000   0.102564103   0.000000000   0.128205128
## 109       0.000000000   0.033333333   0.000000000   0.200000000
## 110       0.007407407   0.000000000   0.000000000   0.200000000
## 111       0.000000000   0.019157088   0.114942529   0.000000000
## 112       0.066666667   0.051851852   0.000000000   0.022222222
## 113       0.000000000   0.121212121   0.000000000   0.060606061
## 114       0.000000000   0.026315789   0.013157895   0.131578947
## 115       0.000000000   0.074074074   0.000000000   0.037037037
## 116       0.000000000   0.117647059   0.000000000   0.078431373
## 117       0.059322034   0.033898305   0.016949153   0.144067797
## 118       0.000000000   0.045454545   0.000000000   0.000000000
## 119       0.000000000   0.136986301   0.000000000   0.000000000
## 120       0.007092199   0.063829787   0.035460993   0.141843972
## 121       0.000000000   0.055837563   0.000000000   0.000000000
## 122       0.031250000   0.078125000   0.093750000   0.000000000
## 123       0.013888889   0.055555556   0.000000000   0.166666667
## 124       0.000000000   0.058823529   0.029411765   0.161764706
## 125       0.000000000   0.000000000   0.000000000   0.043478261
## 126       0.000000000   0.027027027   0.000000000   0.121621622
## 127       0.006060606   0.018181818   0.000000000   0.078787879
## 128       0.000000000   0.160714286   0.017857143   0.017857143
```

```
## 129       0.018867925   0.006289308    0.044025157   0.088050314
## 130       0.027777778   0.027777778    0.055555556   0.055555556
## 131       0.000000000   0.141176471    0.011764706   0.117647059
## 132       0.000000000   0.000000000    0.000000000   0.148936170
## 133       0.012903226   0.025806452    0.006451613   0.070967742
## 134       0.000000000   0.032467532    0.000000000   0.168831169
## 135       0.045454545   0.090909091    0.000000000   0.045454545
## 136       0.000000000   0.038461538    0.153846154   0.038461538
## 137       0.000000000   0.027027027    0.000000000   0.189189189
## 138       0.000000000   0.004878049    0.146341463   0.082926829
## 139       0.000000000   0.214285714    0.000000000   0.000000000
## 140       0.000000000   0.093023256    0.000000000   0.069767442
## 141       0.040540541   0.040540541    0.027027027   0.081081081
## 142       0.000000000   0.023696682    0.000000000   0.000000000
## 143       0.000000000   0.071428571    0.035714286   0.035714286
## 144       0.000000000   0.066666667    0.000000000   0.088888889
## 145       0.000000000   0.103896104    0.051948052   0.000000000
## 146       0.000000000   0.006666667    0.010000000   0.060000000
## 147       0.018181818   0.054545455    0.109090909   0.090909091
## 148       0.000000000   0.093333333    0.000000000   0.013333333
## 149       0.000000000   0.018518519    0.000000000   0.185185185
## 150       0.000000000   0.000000000    0.000000000   0.054054054
## 151       0.000000000   0.016528926    0.041322314   0.190082645
## 152       0.023569024   0.006734007    0.050505051   0.107744108
## 153       0.000000000   0.142857143    0.000000000   0.000000000
## 154       0.000000000   0.042253521    0.000000000   0.042253521
## 155       0.023952096   0.017964072    0.047904192   0.035928144
## 156       0.000000000   0.151515152    0.000000000   0.000000000
## 157       0.000000000   0.035714286    0.000000000   0.178571429
## 158       0.000000000   0.220588235    0.000000000   0.073529412
## 159       0.000000000   0.187500000    0.000000000   0.062500000
## 160       0.019933555   0.026578073    0.026578073   0.069767442
## 161       0.000000000   0.000000000    0.000000000   0.000000000
## 162       0.000000000   0.111111111    0.000000000   0.000000000
## 163       0.000000000   0.034825871    0.000000000   0.029850746
## 164       0.005952381   0.011904762    0.000000000   0.178571429
## 165       0.000000000   0.000000000    0.000000000   0.000000000
## 166       0.034482759   0.044334975    0.034482759   0.083743842
## 167       0.000000000   0.120000000    0.000000000   0.000000000
## 168       0.000000000   0.032679739    0.000000000   0.104575163
## 169       0.000000000   0.090909091    0.000000000   0.060606061
## 170       0.000000000   0.000000000    0.000000000   0.151515152
## 171       0.005555556   0.038888889    0.000000000   0.044444444
## 172       0.000000000   0.000000000    0.000000000   0.000000000
## 173       0.000000000   0.111111111    0.000000000   0.000000000
## 174       0.031250000   0.031250000    0.000000000   0.000000000
## 175       0.000000000   0.071428571    0.035714286   0.178571429
## 176       0.000000000   0.000000000    0.000000000   0.055555556
## 177       0.000000000   0.121212121    0.060606061   0.060606061
## 178       0.000000000   0.036585366    0.121951220   0.060975610
## 179       0.000000000   0.005181347    0.020725389   0.160621762
## 180       0.026315789   0.105263158    0.039473684   0.065789474
## 181       0.000000000   0.000000000    0.000000000   0.052631579
## 182       0.000000000   0.190476190    0.000000000   0.047619048
```

```
## 183       0.049019608   0.019607843    0.009803922   0.078431373
## 184       0.000000000   0.053333333    0.000000000   0.160000000
## 185       0.000000000   0.103448276    0.000000000   0.000000000
## 186       0.000000000   0.017241379    0.008620690   0.103448276
## 187       0.053763441   0.032258065    0.043010753   0.139784946
## 188       0.057692308   0.032051282    0.019230769   0.121794872
## 189       0.000000000   0.048780488    0.000000000   0.195121951
## 190       0.101851852   0.046296296    0.000000000   0.027777778
## 191       0.063291139   0.012658228    0.000000000   0.050632911
## 192       0.000000000   0.111111111    0.000000000   0.000000000
## 193       0.000000000   0.024390244    0.000000000   0.170731707
## 194       0.000000000   0.137931034    0.000000000   0.034482759
## 195       0.000000000   0.091954023    0.000000000   0.022988506
## 196       0.000000000   0.000000000    0.000000000   0.000000000
## 197       0.000000000   0.208333333    0.000000000   0.020833333
## 198       0.000000000   0.021978022    0.054945055   0.065934066
## 199       0.000000000   0.041095890    0.205479452   0.054794521
## 200       0.012618297   0.006309148    0.000000000   0.047318612
## 201       0.000000000   0.076923077    0.000000000   0.153846154
## 202       0.000000000   0.111111111    0.000000000   0.000000000
## 203       0.000000000   0.017341040    0.057803468   0.132947977
## 204       0.000000000   0.059701493    0.000000000   0.000000000
## 205       0.000000000   0.000000000    0.000000000   0.041666667
## 206       0.072625698   0.016759777    0.039106145   0.111731844
## 207       0.012121212   0.054545455    0.018181818   0.060606061
## 208       0.000000000   0.125000000    0.000000000   0.075000000
## 209       0.000000000   0.000000000    0.000000000   0.054545455
## 210       0.023255814   0.116279070    0.000000000   0.093023256
## 211       0.000000000   0.048780488    0.012195122   0.146341463
## 212       0.000000000   0.016759777    0.044692737   0.067039106
## 213       0.000000000   0.016759777    0.022346369   0.167597765
## 214       0.000000000   0.057142857    0.000000000   0.057142857
## 215       0.000000000   0.076923077    0.000000000   0.179487179
## 216       0.032786885   0.049180328    0.000000000   0.098360656
## 217       0.000000000   0.043103448    0.034482759   0.068965517
## 218       0.000000000   0.081395349    0.023255814   0.058139535
## 219       0.018867925   0.018867925    0.000000000   0.075471698
## 220       0.026315789   0.052631579    0.000000000   0.000000000
## 221       0.023809524   0.023809524    0.000000000   0.095238095
## 222       0.106382979   0.085106383    0.000000000   0.042553191
## 223       0.000000000   0.142857143    0.000000000   0.095238095
## 224       0.000000000   0.193548387    0.000000000   0.000000000
## 225       0.000000000   0.052083333    0.000000000   0.000000000
## 226       0.032258065   0.032258065    0.000000000   0.096774194
## 227       0.000000000   0.093750000    0.000000000   0.093750000
## 228       0.004629630   0.018518519    0.000000000   0.032407407
## 229       0.063291139   0.113924051    0.000000000   0.088607595
## 230       0.000000000   0.039800995    0.019900498   0.109452736
## 231       0.012048193   0.072289157    0.000000000   0.000000000
## 232       0.000000000   0.000000000    0.000000000   0.127659574
## 233       0.000000000   0.032558140    0.000000000   0.162790698
## 234       0.000000000   0.040000000    0.000000000   0.200000000
## 235       0.000000000   0.015789474    0.078947368   0.131578947
## 236       0.000000000   0.263157895    0.000000000   0.000000000
```

```
## 237        0.000000000    0.050000000      0.025000000    0.112500000
## 238        0.027027027    0.040540541      0.000000000    0.121621622
## 239        0.038461538    0.000000000      0.000000000    0.038461538
## 240        0.000000000    0.043795620      0.000000000    0.007299270
## 241        0.000000000    0.033333333      0.000000000    0.150000000
## 242        0.003412969    0.020477816      0.034129693    0.174061433
## 243        0.000000000    0.027027027      0.000000000    0.243243243
## 244        0.000000000    0.148148148      0.000000000    0.000000000
## 245        0.003460208    0.065743945      0.010380623    0.048442907
## 246        0.041666667    0.083333333      0.000000000    0.166666667
## 247        0.000000000    0.263157895      0.000000000    0.000000000
## 248        0.000000000    0.230769231      0.000000000    0.000000000
## 249        0.005952381    0.029761905      0.000000000    0.125000000
## 250        0.000000000    0.002433090      0.197080292    0.055961071
## 251        0.000000000    0.016949153      0.067796610    0.169491525
## 252        0.000000000    0.128205128      0.025641026    0.025641026
## 253        0.000000000    0.090909091      0.000000000    0.000000000
## 254        0.014354067    0.011961722      0.000000000    0.026315789
##     notgreennotred_break noobserved_break binconcepts permutation language
## 1             0.042105263      0.052631579           1        2013        0
## 2             0.000000000      0.234375000           1        3120        1
## 3             0.000000000      0.245098039           0         213        0
## 4             0.068493151      0.205479452           0        3021        1
## 5             0.000000000      0.111111111           0        3012        0
## 6             0.035087719      0.122807018           1        2031        1
## 7             0.000000000      0.086206897           0        2310        0
## 8             0.033492823      0.047846890           0         312        0
## 9             0.000000000      0.222222222           1        3210        0
## 10            0.143835616      0.047945205           1        3120        0
## 11            0.000000000      0.217391304           0         312        0
## 12            0.000000000      0.222222222           0        2310        0
## 13            0.015686275      0.156862745           0        2103        1
## 14            0.134615385      0.057692308           1        2031        0
## 15            0.006849315      0.150684932           0         213        0
## 16            0.000000000      0.240000000           0        3021        0
## 17            0.011173184      0.122905028           1         231        0
## 18            0.027777778      0.055555556           1        2031        0
## 19            0.000000000      0.068965517           0         321        1
## 20            0.000000000      0.150000000           1        2031        0
## 21            0.021739130      0.097826087           0         213        0
## 22            0.141592920      0.123893805           0        3012        1
## 23            0.000000000      0.100000000           0        2130        1
## 24            0.000000000      0.051282051           0        1032        1
## 25            0.189189189      0.027027027           1        3120        0
## 26            0.000000000      0.106891702           1        3120        0
## 27            0.023041475      0.198156682           1         231        0
## 28            0.071428571      0.125000000           1        2031        0
## 29            0.047297297      0.047297297           0        1203        0
## 30            0.000000000      0.076923077           1        3120        0
## 31            0.055374593      0.078175896           0        2301        1
## 32            0.000000000      0.121212121           1        3210        1
## 33            0.030303030      0.030303030           1        2031        0
## 34            0.000000000      0.210526316           0         312        0
## 35            0.000000000      0.200000000           0        3021        0
```

```
## 36          0.060606061      0.090909091          0          321         1
## 37          0.000000000      0.265625000          0          312         0
## 38          0.000000000      0.268292683          0          123         0
## 39          0.038834951      0.087378641          1         2013         1
## 40          0.035087719      0.070175439          0         3102         0
## 41          0.000000000      0.269230769          0         1203         0
## 42          0.000000000      0.081967213          1         3120         0
## 43          0.014492754      0.144927536          1         2031         0
## 44          0.115384615      0.115384615          0         2301         1
## 45          0.000000000      0.243902439          1         2031         1
## 46          0.062500000      0.175000000          1          231         0
## 47          0.050847458      0.000000000          1          231         0
## 48          0.052631579      0.105263158          0         3102         0
## 49          0.177777778      0.088888889          0         2103         1
## 50          0.000000000      0.263157895          0          123         0
## 51          0.000000000      0.170212766          1         3120         0
## 52          0.085714286      0.114285714          1         2013         0
## 53          0.044444444      0.088888889          1          231         0
## 54          0.000000000      0.265625000          0          123         1
## 55          0.000000000      0.195652174          0         3021         0
## 56          0.115384615      0.051282051          1          231         1
## 57          0.165562914      0.046357616          0          213         0
## 58          0.000000000      0.217391304          0         1320         0
## 59          0.178030303      0.030303030          0         3012         1
## 60          0.000000000      0.217741935          1         3120         0
## 61          0.000000000      0.000000000          1          231         0
## 62          0.000000000      0.094339623          1          231         0
## 63          0.000000000      0.066666667          0         3021         0
## 64          0.139534884      0.000000000          1         3120         1
## 65          0.092783505      0.164948454          1          231         0
## 66          0.000000000      0.155555556          0         1023         1
## 67          0.147727273      0.051136364          0         1320         0
## 68          0.060606061      0.050505051          1          231         0
## 69          0.000000000      0.045454545          0          321         0
## 70          0.000000000      0.277777778          0          213         0
## 71          0.000000000      0.050000000          1         3210         1
## 72          0.056818182      0.059090909          0          213         0
## 73          0.121693122      0.126984127          0         1032         0
## 74          0.007407407      0.051851852          1         2013         0
## 75          0.040000000      0.080000000          1         2031         0
## 76          0.000000000      0.200000000          0          312         0
## 77          0.000000000      0.125786164          1         2031         0
## 78          0.000000000      0.111111111          1         3210         0
## 79          0.000000000      0.028846154          1         3120         1
## 80          0.001754386      0.066666667          1          231         0
## 81          0.082840237      0.059171598          0         1230         0
## 82          0.122994652      0.106951872          0         2130         0
## 83          0.000000000      0.266666667          0         3012         0
## 84          0.000000000      0.187500000          0         2130         0
## 85          0.036144578      0.096385542          1          231         0
## 86          0.000000000      0.098039216          1         3210         1
## 87          0.188679245      0.037735849          1         3120         1
## 88          0.052083333      0.062500000          0          213         0
## 89          0.013953488      0.083720930          1         3120         0
```

```
## 90          0.000000000     0.105263158     1       3210    0
## 91          0.000000000     0.209302326     0       3012    0
## 92          0.000000000     0.064516129     1        231    0
## 93          0.030379747     0.113924051     1       3120    0
## 94          0.207547170     0.056603774     1       2031    0
## 95          0.000000000     0.086956522     0       2130    0
## 96          0.027027027     0.243243243     0       2103    0
## 97          0.000000000     0.222222222     0        123    0
## 98          0.000000000     0.067961165     1       2031    0
## 99          0.000000000     0.086956522     0       3102    1
## 100         0.000000000     0.235955056     0        213    1
## 101         0.006756757     0.094594595     0        321    0
## 102         0.000000000     0.272727273     1       2013    0
## 103         0.032258065     0.161290323     0        213    0
## 104         0.083333333     0.152777778     0        213    0
## 105         0.017777778     0.257777778     0       3012    1
## 106         0.138461538     0.046153846     0       3012    1
## 107         0.144736842     0.118421053     1       3210    1
## 108         0.025641026     0.102564103     0        312    1
## 109         0.000000000     0.033333333     1       3120    1
## 110         0.007407407     0.066666667     0       3012    1
## 111         0.026819923     0.134099617     1       3210    0
## 112         0.111111111     0.140740741     1       3120    0
## 113         0.000000000     0.181818182     0       3012    1
## 114         0.013157895     0.105263158     1        231    0
## 115         0.074074074     0.111111111     0       3012    0
## 116         0.000000000     0.176470588     0        213    0
## 117         0.059322034     0.050847458     1       2031    1
## 118         0.000000000     0.272727273     0        321    0
## 119         0.000000000     0.260273973     0       2103    0
## 120         0.014184397     0.085106383     1       2031    1
## 121         0.010152284     0.269035533     0        123    0
## 122         0.062500000     0.109375000     1       2013    0
## 123         0.055555556     0.041666667     0       1032    1
## 124         0.058823529     0.014705882     1       2013    0
## 125         0.014492754     0.202898551     0        213    0
## 126         0.094594595     0.054054054     1        231    1
## 127         0.006060606     0.072727273     0       3012    1
## 128         0.000000000     0.214285714     0       3021    0
## 129         0.100628931     0.044025157     0       2103    1
## 130         0.083333333     0.055555556     1       2013    0
## 131         0.011764706     0.129411765     0       1302    1
## 132         0.085106383     0.021276596     1       2013    1
## 133         0.129032258     0.070967742     1       3120    1
## 134         0.000000000     0.103896104     0       2310    1
## 135         0.090909091     0.090909091     0       3012    0
## 136         0.000000000     0.038461538     1       2031    0
## 137         0.000000000     0.054054054     1       3120    0
## 138         0.000000000     0.048780488     1        231    0
## 139         0.000000000     0.214285714     0       2130    0
## 140         0.000000000     0.162790698     0        213    0
## 141         0.081081081     0.081081081     1       2031    0
## 142         0.000000000     0.180094787     0       3102    0
## 143         0.071428571     0.107142857     0        213    0
```

```
## 144        0.000000000     0.177777778        0       3012        0
## 145        0.000000000     0.220779221        1        231        0
## 146        0.160000000     0.050000000        1       2031        1
## 147        0.018181818     0.036363636        1       2031        1
## 148        0.000000000     0.253333333        1       2013        0
## 149        0.000000000     0.074074074        1       3120        0
## 150        0.027027027     0.162162162        0       3021        0
## 151        0.016528926     0.024793388        1        231        0
## 152        0.077441077     0.037037037        1        231        1
## 153        0.000000000     0.238095238        0       2103        0
## 154        0.000000000     0.225352113        0       2130        0
## 155        0.119760479     0.071856287        1       3120        0
## 156        0.000000000     0.242424242        0       1203        0
## 157        0.000000000     0.071428571        0       3102        0
## 158        0.000000000     0.191176471        0       2310        0
## 159        0.000000000     0.125000000        0       2103        0
## 160        0.096345515     0.086378738        0        213        0
## 161        0.000000000     0.250000000        0       3201        0
## 162        0.000000000     0.222222222        0       3021        1
## 163        0.000000000     0.248756219        0       1320        0
## 164        0.059523810     0.035714286        1        231        0
## 165        0.000000000     0.222222222        0       2301        0
## 166        0.093596059     0.064039409        1       2031        0
## 167        0.000000000     0.240000000        1       3210        0
## 168        0.000000000     0.169934641        0       3102        1
## 169        0.000000000     0.212121212        1       3120        0
## 170        0.106060606     0.015151515        0       2310        1
## 171        0.016666667     0.211111111        0       3012        1
## 172        0.027972028     0.237762238        0        312        0
## 173        0.000000000     0.222222222        0        213        0
## 174        0.187500000     0.062500000        0        312        1
## 175        0.000000000     0.035714286        1        231        0
## 176        0.000000000     0.166666667        0       3102        0
## 177        0.030303030     0.121212121        1       2013        0
## 178        0.000000000     0.085365854        1       2031        0
## 179        0.005181347     0.093264249        1       2031        0
## 180        0.039473684     0.118421053        1       2031        0
## 181        0.052631579     0.105263158        0       3012        0
## 182        0.000000000     0.190476190        0       1320        0
## 183        0.127450980     0.058823529        1       2031        0
## 184        0.000000000     0.106666667        0       3102        1
## 185        0.000000000     0.241379310        0       3012        0
## 186        0.146551724     0.008620690        0       3021        1
## 187        0.043010753     0.043010753        1       2031        1
## 188        0.102564103     0.032051282        1        231        1
## 189        0.000000000     0.073170732        0       3102        0
## 190        0.203703704     0.037037037        0        312        0
## 191        0.151898734     0.050632911        0       3201        0
## 192        0.000000000     0.259259259        0       3012        1
## 193        0.024390244     0.048780488        1       2013        0
## 194        0.000000000     0.206896552        0       2130        0
## 195        0.022988506     0.206896552        0        123        0
## 196        0.000000000     0.238095238        0        213        0
## 197        0.000000000     0.229166667        0       2130        1
```

```
## 198  0.021978022  0.120879121  1  231  0
## 199  0.000000000  0.013698630  1  2031  0
## 200  0.129337539  0.100946372  0  2310  1
## 201  0.000000000  0.076923077  0  3012  0
## 202  0.000000000  0.222222222  0  1302  0
## 203  0.017341040  0.069364162  1  231  1
## 204  0.000000000  0.268656716  0  3201  0
## 205  0.125000000  0.083333333  0  213  1
## 206  0.083798883  0.039106145  1  2031  1
## 207  0.066666667  0.127272727  1  231  1
## 208  0.000000000  0.175000000  0  3102  0
## 209  0.072727273  0.127272727  0  2130  0
## 210  0.069767442  0.093023256  0  123  0
## 211  0.048780488  0.060975610  1  2013  0
## 212  0.022346369  0.139664804  1  231  0
## 213  0.033519553  0.055865922  0  213  0
## 214  0.000000000  0.171428571  1  2013  0
## 215  0.000000000  0.076923077  1  2013  0
## 216  0.081967213  0.081967213  1  3210  1
## 217  0.017241379  0.146551724  1  2031  0
## 218  0.011627907  0.174418605  0  1320  0
## 219  0.150943396  0.037735849  1  3120  0
## 220  0.052631579  0.210526316  0  3012  0
## 221  0.023809524  0.119047619  0  3021  1
## 222  0.127659574  0.085106383  0  321  1
## 223  0.047619048  0.095238095  0  2103  0
## 224  0.000000000  0.225806452  0  213  0
## 225  0.000000000  0.270833333  0  312  1
## 226  0.096774194  0.064516129  1  3120  1
## 227  0.031250000  0.125000000  0  3021  0
## 228  0.074074074  0.171296296  1  231  0
## 229  0.075949367  0.101265823  0  2310  0
## 230  0.024875622  0.124378109  1  2031  0
## 231  0.048192771  0.216867470  1  3120  0
## 232  0.106382979  0.042553191  0  3102  1
## 233  0.000000000  0.116279070  1  3120  0
## 234  0.000000000  0.060000000  0  1230  0
## 235  0.021052632  0.042105263  1  2013  0
## 236  0.000000000  0.210526316  0  1023  0
## 237  0.050000000  0.075000000  0  3012  1
## 238  0.040540541  0.108108108  0  3201  0
## 239  0.115384615  0.076923077  0  2130  1
## 240  0.197080292  0.058394161  1  231  0
## 241  0.000000000  0.100000000  0  2130  1
## 242  0.027303754  0.044368601  0  1023  0
## 243  0.000000000  0.027027027  1  3120  0
## 244  0.000000000  0.259259259  0  3021  0
## 245  0.013840830  0.207612457  1  3120  1
## 246  0.000000000  0.083333333  0  3012  1
## 247  0.000000000  0.263157895  0  3012  0
## 248  0.000000000  0.153846154  0  3012  0
## 249  0.029761905  0.119047619  0  213  1
## 250  0.000000000  0.003649635  1  2031  0
## 251  0.016949153  0.016949153  1  231  0
```

```
## 252          0.000000000      0.217948718           1        2013        0
## 253          0.000000000      0.181818182           0        3021        1
## 254          0.141148325      0.114832536           0        3012        1
##     german french field chemistry textiles biology fast pharma year firsty
## 1        1      0     0         1        0       0    0      0    0       1
## 2        0      1     0         1        0       0    0      0    1       0
## 3        1      0     1         0        1       0    0      0    2       0
## 4        0      1     0         1        0       0    0      0    0       1
## 5        1      0     1         0        1       0    0      0    2       0
## 6        0      1     0         1        0       0    0      0    1       0
## 7        1      0     1         0        1       0    0      0    1       0
## 8        1      0     1         0        1       0    0      0    0       1
## 9        1      0     0         1        0       0    0      0    2       0
## 10       1      0     1         0        1       0    0      0    0       1
## 11       1      0     0         1        0       0    0      0    0       1
## 12       1      0     2         0        0       1    0      0    1       0
## 13       0      1     0         1        0       0    0      0    0       1
## 14       1      0     0         1        0       0    0      0    2       0
## 15       1      0     0         1        0       0    0      0    2       0
## 16       1      0     0         1        0       0    0      0    1       0
## 17       1      0     1         0        1       0    0      0    1       0
## 18       1      0     1         0        1       0    0      0    2       0
## 19       0      1     2         0        0       1    0      0    1       0
## 20       1      0     1         0        1       0    0      0    2       0
## 21       1      0     1         0        1       0    0      0    2       0
## 22       0      1     2         0        0       1    0      0    1       0
## 23       0      1     2         0        0       1    0      0    0       1
## 24       0      1     0         1        0       0    0      0    0       1
## 25       1      0     0         1        0       0    0      0    2       0
## 26       1      0     0         1        0       0    0      0    1       0
## 27       1      0     0         1        0       0    0      0    0       1
## 28       1      0     0         1        0       0    0      0    2       0
## 29       1      0     1         0        1       0    0      0    1       0
## 30       1      0     0         1        0       0    0      0    1       0
## 31       0      1     0         1        0       0    0      0    1       0
## 32       0      1     0         1        0       0    0      0    0       1
## 33       1      0     2         0        0       1    0      0    1       0
## 34       1      0     0         1        0       0    0      0    0       1
## 35       1      0     2         0        0       1    0      0    1       0
## 36       0      1     0         1        0       0    0      0    1       0
## 37       1      0     0         1        0       0    0      0    2       0
## 38       1      0     0         1        0       0    0      0    1       0
## 39       0      1     0         1        0       0    0      0    0       1
## 40       1      0     0         1        0       0    0      0    1       0
## 41       1      0     0         1        0       0    0      0    0       1
## 42       1      0     0         1        0       0    0      0    1       0
## 43       1      0     0         1        0       0    0      0    2       0
## 44       0      1     0         1        0       0    0      0    1       0
## 45       0      1     0         1        0       0    0      0    1       0
## 46       1      0     0         1        0       0    0      0    1       0
## 47       1      0     1         0        1       0    0      0    1       0
## 48       1      0     0         1        0       0    0      0    1       0
## 49       0      1     0         1        0       0    0      0    0       1
## 50       1      0     0         1        0       0    0      0    0       1
```

```
## 51      1      0      1      0      1      0      0      0      0      1
## 52      1      0      0      1      0      0      0      0      2      0
## 53      1      0      0      1      0      0      0      0      0      1
## 54      0      1      3      0      0      0      1      0      0      1
## 55      1      0      4      0      0      0      0      1      0      1
## 56      0      1      0      1      0      0      0      0      0      1
## 57      1      0      0      1      0      0      0      0      2      0
## 58      1      0      1      0      1      0      0      0      0      1
## 59      0      1      2      0      0      1      0      0      0      1
## 60      1      0      0      1      0      0      0      0      0      1
## 61      1      0      0      1      0      0      0      0      2      0
## 62      1      0      1      0      1      0      0      0      2      0
## 63      1      0      1      0      1      0      0      0      0      1
## 64      0      1      0      1      0      0      0      0      1      0
## 65      1      0      0      1      0      0      0      0      1      0
## 66      0      1      2      0      0      1      0      0      1      0
## 67      1      0      1      0      1      0      0      0      0      1
## 68      1      0      4      0      0      0      0      1      0      1
## 69      1      0      0      1      0      0      0      0      2      0
## 70      1      0      1      0      1      0      0      0      2      0
## 71      0      1      0      1      0      0      0      0      0      1
## 72      1      0      0      1      0      0      0      0      1      0
## 73      1      0      1      0      1      0      0      0      0      1
## 74      1      0      0      1      0      0      0      0      1      0
## 75      1      0      0      1      0      0      0      0      1      0
## 76      1      0      0      1      0      0      0      0      0      1
## 77      1      0      0      1      0      0      0      0      0      1
## 78      1      0      0      1      0      0      0      0      0      1
## 79      0      1      0      1      0      0      0      0      1      0
## 80      1      0      1      0      1      0      0      0      2      0
## 81      1      0      0      1      0      0      0      0      1      0
## 82      1      0      0      1      0      0      0      0      1      0
## 83      1      0      0      1      0      0      0      0      1      0
## 84      1      0      0      1      0      0      0      0      1      0
## 85      1      0      0      1      0      0      0      0      1      0
## 86      0      1      0      1      0      0      0      0      0      1
## 87      0      1      0      1      0      0      0      0      0      1
## 88      1      0      1      0      1      0      0      0      0      1
## 89      1      0      1      0      1      0      0      0      2      0
## 90      1      0      1      0      1      0      0      0      2      0
## 91      1      0      0      1      0      0      0      0      1      0
## 92      1      0      0      1      0      0      0      0      2      0
## 93      1      0      0      1      0      0      0      0      0      1
## 94      1      0      0      1      0      0      0      0      2      0
## 95      1      0      0      1      0      0      0      0      2      0
## 96      1      0      0      1      0      0      0      0      1      0
## 97      1      0      0      1      0      0      0      0      0      1
## 98      1      0      0      1      0      0      0      0      0      1
## 99      0      1      0      1      0      0      0      0      0      1
## 100     0      1      2      0      0      1      0      0      1      0
## 101     1      0      0      1      0      0      0      0      0      1
## 102     1      0      1      0      1      0      0      0      2      0
## 103     1      0      1      0      1      0      0      0      2      0
## 104     1      0      1      0      1      0      0      0      0      1
```

```
## 105     0     1     0     1     0     0     0     0     0     1
## 106     0     1     3     0     0     0     1     0     0     1
## 107     0     1     3     0     0     0     1     0     0     1
## 108     0     1     0     1     0     0     0     0     0     1
## 109     0     1     0     1     0     0     0     0     1     0
## 110     0     1     2     0     0     1     0     0     1     0
## 111     1     0     1     0     1     0     0     0     0     1
## 112     1     0     2     0     0     1     0     0     1     0
## 113     0     1     0     1     0     0     0     0     1     0
## 114     1     0     0     1     0     0     0     0     2     0
## 115     1     0     4     0     0     0     0     1     0     1
## 116     1     0     2     0     0     1     0     0     1     0
## 117     0     1     0     1     0     0     0     0     1     0
## 118     1     0     2     0     0     1     0     0     1     0
## 119     1     0     4     0     0     0     0     1     0     1
## 120     0     1     0     1     0     0     0     0     1     0
## 121     1     0     4     0     0     0     0     1     0     1
## 122     1     0     0     1     0     0     0     0     1     0
## 123     0     1     2     0     0     1     0     0     0     1
## 124     1     0     1     0     1     0     0     0     0     1
## 125     1     0     4     0     0     0     0     1     0     1
## 126     0     1     0     1     0     0     0     0     1     0
## 127     0     1     0     1     0     0     0     0     0     1
## 128     1     0     0     1     0     0     0     0     0     1
## 129     0     1     0     1     0     0     0     0     0     1
## 130     1     0     2     0     0     1     0     0     1     0
## 131     0     1     0     1     0     0     0     0     0     1
## 132     0     1     0     1     0     0     0     0     1     0
## 133     0     1     0     1     0     0     0     0     0     1
## 134     0     1     0     1     0     0     0     0     1     0
## 135     1     0     0     1     0     0     0     0     2     0
## 136     1     0     0     1     0     0     0     0     1     0
## 137     1     0     0     1     0     0     0     0     1     0
## 138     1     0     0     1     0     0     0     0     1     0
## 139     1     0     0     1     0     0     0     0     1     0
## 140     1     0     0     1     0     0     0     0     2     0
## 141     1     0     0     1     0     0     0     0     1     0
## 142     1     0     4     0     0     0     0     1     0     1
## 143     1     0     0     1     0     0     0     0     0     1
## 144     1     0     0     1     0     0     0     0     1     0
## 145     1     0     0     1     0     0     0     0     2     0
## 146     0     1     0     1     0     0     0     0     0     1
## 147     0     1     0     1     0     0     0     0     1     0
## 148     1     0     0     1     0     0     0     0     1     0
## 149     1     0     1     0     1     0     0     0     1     0
## 150     1     0     0     1     0     0     0     0     2     0
## 151     1     0     0     1     0     0     0     0     0     1
## 152     0     1     0     1     0     0     0     0     1     0
## 153     1     0     0     1     0     0     0     0     0     1
## 154     1     0     1     0     1     0     0     0     1     0
## 155     1     0     1     0     1     0     0     0     1     0
## 156     1     0     0     1     0     0     0     0     1     0
## 157     1     0     1     0     1     0     0     0     1     0
## 158     1     0     1     0     1     0     0     0     1     0
```

```
## 159      1      0      0          1          0      0      0      0      1      0
## 160      1      0      0          1          0      0      0      0      1      0
## 161      1      0      4          0          0      0      0      1      0      1
## 162      0      1      3          0          0      0      1      0      0      1
## 163      1      0      4          0          0      0      0      1      0      1
## 164      1      0      0          1          0      0      0      0      0      1
## 165      1      0      0          1          0      0      0      0      0      1
## 166      1      0      0          1          0      0      0      0      1      0
## 167      1      0      0          1          0      0      0      0      1      0
## 168      0      1      0          1          0      0      0      0      1      0
## 169      1      0      0          1          0      0      0      0      0      1
## 170      0      1      0          1          0      0      0      0      1      0
## 171      0      1      0          1          0      0      0      0      0      1
## 172      1      0      0          1          0      0      0      0      2      0
## 173      1      0      0          1          0      0      0      0      0      1
## 174      0      1      0          1          0      0      0      0      0      1
## 175      1      0      0          1          0      0      0      0      2      0
## 176      1      0      0          1          0      0      0      0      2      0
## 177      1      0      0          1          0      0      0      0      1      0
## 178      1      0      1          0          1      0      0      0      2      0
## 179      1      0      1          0          1      0      0      0      2      0
## 180      1      0      1          0          1      0      0      0      2      0
## 181      1      0      0          1          0      0      0      0      1      0
## 182      1      0      2          0          0      1      0      0      1      0
## 183      1      0      2          0          0      1      0      0      1      0
## 184      0      1      3          0          0      0      1      0      0      1
## 185      1      0      4          0          0      0      0      1      0      1
## 186      0      1      0          1          0      0      0      0      1      0
## 187      0      1      0          1          0      0      0      0      0      1
## 188      0      1      2          0          0      1      0      0      1      0
## 189      1      0      0          1          0      0      0      0      1      0
## 190      1      0      1          0          1      0      0      0      1      0
## 191      1      0      1          0          1      0      0      0      2      0
## 192      0      1      0          1          0      0      0      0      1      0
## 193      1      0      2          0          0      1      0      0      1      0
## 194      1      0      0          1          0      0      0      0      1      0
## 195      1      0      0          1          0      0      0      0      1      0
## 196      1      0      0          1          0      0      0      0      1      0
## 197      0      1      0          1          0      0      0      0      0      1
## 198      1      0      0          1          0      0      0      0      1      0
## 199      1      0      0          1          0      0      0      0      1      0
## 200      0      1      2          0          0      1      0      0      1      0
## 201      1      0      1          0          1      0      0      0      2      0
## 202      1      0      1          0          1      0      0      0      1      0
## 203      0      1      2          0          0      1      0      0      1      0
## 204      1      0      0          1          0      0      0      0      1      0
## 205      0      1      0          1          0      0      0      0      0      1
## 206      0      1      0          1          0      0      0      0      1      0
## 207      0      1      0          1          0      0      0      0      0      1
## 208      1      0      0          1          0      0      0      0      1      0
## 209      1      0      0          1          0      0      0      0      2      0
## 210      1      0      1          0          1      0      0      0      1      0
## 211      1      0      1          0          1      0      0      0      0      1
## 212      1      0      1          0          1      0      0      0      2      0
```

```
## 213      1      0     0         1        0       0    0      0    0      1
## 214      1      0     0         1        0       0    0      0    1      0
## 215      1      0     0         1        0       0    0      0    2      0
## 216      0      1     0         1        0       0    0      0    0      1
## 217      1      0     0         1        0       0    0      0    0      1
## 218      1      0     1         0        1       0    0      0    2      0
## 219      1      0     1         0        1       0    0      0    2      0
## 220      1      0     0         1        0       0    0      0    1      0
## 221      0      1     2         0        0       1    0      0    1      0
## 222      0      1     0         1        0       0    0      0    1      0
## 223      1      0     4         0        0       0    0      1    0      1
## 224      1      0     0         1        0       0    0      0    1      0
## 225      0      1     0         1        0       0    0      0    0      1
## 226      0      1     0         1        0       0    0      0    0      1
## 227      1      0     0         1        0       0    0      0    0      1
## 228      1      0     1         0        1       0    0      0    0      1
## 229      1      0     1         0        1       0    0      0    1      0
## 230      1      0     1         0        1       0    0      0    0      1
## 231      1      0     0         1        0       0    0      0    1      0
## 232      0      1     2         0        0       1    0      0    1      0
## 233      1      0     0         1        0       0    0      0    2      0
## 234      1      0     4         0        0       0    0      1    0      1
## 235      1      0     1         0        1       0    0      0    2      0
## 236      1      0     0         1        0       0    0      0    0      1
## 237      0      1     0         1        0       0    0      0    0      1
## 238      1      0     0         1        0       0    0      0    0      1
## 239      0      1     2         0        0       1    0      0    0      1
## 240      1      0     0         1        0       0    0      0    1      0
## 241      0      1     0         1        0       0    0      0    0      1
## 242      1      0     0         1        0       0    0      0    1      0
## 243      1      0     1         0        1       0    0      0    1      0
## 244      1      0     0         1        0       0    0      0    1      0
## 245      0      1     0         1        0       0    0      0    1      0
## 246      0      1     0         1        0       0    0      0    0      1
## 247      1      0     1         0        1       0    0      0    2      0
## 248      1      0     0         1        0       0    0      0    0      1
## 249      0      1     0         1        0       0    0      0    0      1
## 250      1      0     1         0        1       0    0      0    2      0
## 251      1      0     0         1        0       0    0      0    2      0
## 252      1      0     1         0        1       0    0      0    0      1
## 253      0      1     0         1        0       0    0      0    1      0
## 254      0      1     2         0        0       1    0      0    0      1
##     secondy thirdy gender male female other
## 1         0      0      1    0      1     0
## 2         1      0      0    1      0     0
## 3         0      1      0    1      0     0
## 4         0      0      0    1      0     0
## 5         0      1      0    1      0     0
## 6         1      0      0    1      0     0
## 7         1      0      1    0      1     0
## 8         0      0      0    1      0     0
## 9         0      1      2    0      0     1
## 10        0      0      1    0      1     0
## 11        0      0      0    1      0     0
```

```
## 12      1      0      3      0      0      1
## 13      0      0      0      1      0      0
## 14      0      1      1      0      1      0
## 15      0      1      1      0      1      0
## 16      1      0      0      1      0      0
## 17      1      0      1      0      1      0
## 18      0      1      1      0      1      0
## 19      1      0      3      0      0      1
## 20      0      1      0      1      0      0
## 21      0      1      1      0      1      0
## 22      1      0      1      0      1      0
## 23      0      0      0      1      0      0
## 24      0      0      0      1      0      0
## 25      0      1      1      0      1      0
## 26      1      0      1      0      1      0
## 27      0      0      1      0      1      0
## 28      0      1      1      0      1      0
## 29      1      0      0      1      0      0
## 30      1      0      1      0      1      0
## 31      1      0      0      1      0      0
## 32      0      0      0      1      0      0
## 33      1      0      0      1      0      0
## 34      0      0      1      0      1      0
## 35      1      0      1      0      1      0
## 36      1      0      1      0      1      0
## 37      0      1      0      1      0      0
## 38      1      0      0      1      0      0
## 39      0      0      0      1      0      0
## 40      1      0      1      0      1      0
## 41      0      0      0      1      0      0
## 42      1      0      0      1      0      0
## 43      0      1      0      1      0      0
## 44      1      0      1      0      1      0
## 45      1      0      0      1      0      0
## 46      1      0      0      1      0      0
## 47      1      0      0      1      0      0
## 48      1      0      0      1      0      0
## 49      0      0      0      1      0      0
## 50      0      0      0      1      0      0
## 51      0      0      0      1      0      0
## 52      0      1      0      1      0      0
## 53      0      0      1      0      1      0
## 54      0      0      1      0      1      0
## 55      0      0      0      1      0      0
## 56      0      0      3      0      0      1
## 57      0      1      1      0      1      0
## 58      0      0      1      0      1      0
## 59      0      0      2      0      0      1
## 60      0      0      1      0      1      0
## 61      0      1      1      0      1      0
## 62      0      1      0      1      0      0
## 63      0      0      1      0      1      0
## 64      1      0      1      0      1      0
## 65      1      0      1      0      1      0
```

```
## 66       1       0       1       0       1       0
## 67       0       0       0       1       0       0
## 68       0       0       0       1       0       0
## 69       0       1       3       0       0       1
## 70       0       1       1       0       1       0
## 71       0       0       1       0       1       0
## 72       1       0       1       0       1       0
## 73       0       0       1       0       1       0
## 74       1       0       0       1       0       0
## 75       1       0       0       1       0       0
## 76       0       0       0       1       0       0
## 77       0       0       1       0       1       0
## 78       0       0       0       1       0       0
## 79       1       0       0       1       0       0
## 80       0       1       1       0       1       0
## 81       1       0       1       0       1       0
## 82       1       0       1       0       1       0
## 83       1       0       3       0       0       1
## 84       1       0       1       0       1       0
## 85       1       0       0       1       0       0
## 86       0       0       1       0       1       0
## 87       0       0       1       0       1       0
## 88       0       0       0       1       0       0
## 89       0       1       0       1       0       0
## 90       0       1       0       1       0       0
## 91       1       0       1       0       1       0
## 92       0       1       3       0       0       1
## 93       0       0       0       1       0       0
## 94       0       1       0       1       0       0
## 95       0       1       1       0       1       0
## 96       1       0       1       0       1       0
## 97       0       0       0       1       0       0
## 98       0       0       0       1       0       0
## 99       0       0       0       1       0       0
## 100      1       0       1       0       1       0
## 101      0       0       1       0       1       0
## 102      0       1       1       0       1       0
## 103      0       1       0       1       0       0
## 104      0       0       1       0       1       0
## 105      0       0       0       1       0       0
## 106      0       0       1       0       1       0
## 107      0       0       1       0       1       0
## 108      0       0       0       1       0       0
## 109      1       0       0       1       0       0
## 110      1       0       0       1       0       0
## 111      0       0       1       0       1       0
## 112      1       0       0       1       0       0
## 113      1       0       1       0       1       0
## 114      0       1       1       0       1       0
## 115      0       0       0       1       0       0
## 116      1       0       0       1       0       0
## 117      1       0       0       1       0       0
## 118      1       0       1       0       1       0
## 119      0       0       0       1       0       0
```

```
## 120      1      0      1      0      1      0
## 121      0      0      0      1      0      0
## 122      1      0      0      1      0      0
## 123      0      0      1      0      1      0
## 124      0      0      1      0      1      0
## 125      0      0      0      1      0      0
## 126      1      0      1      0      1      0
## 127      0      0      1      0      1      0
## 128      0      0      1      0      1      0
## 129      0      0      0      1      0      0
## 130      1      0      1      0      1      0
## 131      0      0      1      0      1      0
## 132      1      0      1      0      1      0
## 133      0      0      0      1      0      0
## 134      1      0      0      1      0      0
## 135      0      1      0      1      0      0
## 136      1      0      0      1      0      0
## 137      1      0      1      0      1      0
## 138      1      0      1      0      1      0
## 139      1      0      1      0      1      0
## 140      0      1      0      1      0      0
## 141      1      0      0      1      0      0
## 142      0      0      0      1      0      0
## 143      0      0      0      1      0      0
## 144      1      0      0      1      0      0
## 145      0      1      0      1      0      0
## 146      0      0      0      1      0      0
## 147      1      0      0      1      0      0
## 148      1      0      1      0      1      0
## 149      1      0      0      1      0      0
## 150      0      1      1      0      1      0
## 151      0      0      0      1      0      0
## 152      1      0      0      1      0      0
## 153      0      0      1      0      1      0
## 154      1      0      1      0      1      0
## 155      1      0      1      0      1      0
## 156      1      0      0      1      0      0
## 157      1      0      1      0      1      0
## 158      1      0      1      0      1      0
## 159      1      0      0      1      0      0
## 160      1      0      1      0      1      0
## 161      0      0      0      1      0      0
## 162      0      0      0      1      0      0
## 163      0      0      0      1      0      0
## 164      0      0      1      0      1      0
## 165      0      0      0      1      0      0
## 166      1      0      0      1      0      0
## 167      1      0      0      1      0      0
## 168      1      0      0      1      0      0
## 169      0      0      1      0      1      0
## 170      1      0      0      1      0      0
## 171      0      0      0      1      0      0
## 172      0      1      0      1      0      0
## 173      0      0      0      1      0      0
```

```
## 174      0      0      3      0      0      1
## 175      0      1      0      1      0      0
## 176      0      1      1      0      1      0
## 177      1      0      1      0      1      0
## 178      0      1      1      0      1      0
## 179      0      1      0      1      0      0
## 180      0      1      1      0      1      0
## 181      1      0      0      1      0      0
## 182      1      0      0      1      0      0
## 183      1      0      1      0      1      0
## 184      0      0      1      0      1      0
## 185      0      0      0      1      0      0
## 186      1      0      0      1      0      0
## 187      0      0      0      1      0      0
## 188      1      0      1      0      1      0
## 189      1      0      1      0      1      0
## 190      1      0      0      1      0      0
## 191      0      1      2      0      0      1
## 192      1      0      0      1      0      0
## 193      1      0      0      1      0      0
## 194      1      0      1      0      1      0
## 195      1      0      0      1      0      0
## 196      1      0      0      1      0      0
## 197      0      0      0      1      0      0
## 198      1      0      1      0      1      0
## 199      1      0      1      0      1      0
## 200      1      0      0      1      0      0
## 201      0      1      0      1      0      0
## 202      1      0      1      0      1      0
## 203      1      0      1      0      1      0
## 204      1      0      0      1      0      0
## 205      0      0      0      1      0      0
## 206      1      0      0      1      0      0
## 207      0      0      0      1      0      0
## 208      1      0      1      0      1      0
## 209      0      1      0      1      0      0
## 210      1      0      0      1      0      0
## 211      0      0      0      1      0      0
## 212      0      1      0      1      0      0
## 213      0      0      0      1      0      0
## 214      1      0      0      1      0      0
## 215      0      1      0      1      0      0
## 216      0      0      0      1      0      0
## 217      0      0      1      0      1      0
## 218      0      1      1      0      1      0
## 219      0      1      1      0      1      0
## 220      1      0      1      0      1      0
## 221      1      0      1      0      1      0
## 222      1      0      1      0      1      0
## 223      0      0      0      1      0      0
## 224      1      0      1      0      1      0
## 225      0      0      1      0      1      0
## 226      0      0      0      1      0      0
## 227      0      0      0      1      0      0
```

```
## 228      0      0      1      0      1      0
## 229      1      0      0      1      0      0
## 230      0      0      1      0      1      0
## 231      1      0      1      0      1      0
## 232      1      0      2      0      0      1
## 233      0      1      1      0      1      0
## 234      0      0      0      1      0      0
## 235      0      1      1      0      1      0
## 236      0      0      0      1      0      0
## 237      0      0      1      0      1      0
## 238      0      0      1      0      1      0
## 239      0      0      0      1      0      0
## 240      1      0      1      0      1      0
## 241      0      0      0      1      0      0
## 242      1      0      0      1      0      0
## 243      1      0      0      1      0      0
## 244      1      0      0      1      0      0
## 245      1      0      0      1      0      0
## 246      0      0      0      1      0      0
## 247      0      1      0      1      0      0
## 248      0      0      0      1      0      0
## 249      0      0      0      1      0      0
## 250      0      1      1      0      1      0
## 251      0      1      1      0      1      0
## 252      0      0      0      1      0      0
## 253      1      0      0      1      0      0
## 254      0      0      1      0      1      0
```