Iris Data

Alan n. Inglis

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Load libraries:

```
library(bartMachine) # for model
library(dbarts) # for model
library(bartMan) # for visualizations
library(ggplot2) # for visualizations
```

Read in and setup data:

```
# load data
data(iris)
iris2 = iris[1:100,]
iris2$Species <- factor(iris2$Species)
iris2$Species <- ifelse(iris2$Species == "setosa", 0, 1)
```

Build models

```
# bartMachine
set.seed(100)
bm <-  bartMachine(X = iris2[,1:4],
                   y = iris2[,5],
                   num_burn_in = 250,
                   num_trees = 20,
                   seed = 100)
```

```
## bartMachine initializing with 20 trees...
## bartMachine vars checked...
## bartMachine java init...
## bartMachine factors created...
## bartMachine before preprocess...
## bartMachine after preprocess... 5 total features...
## bartMachine sigsq estimated...
## bartMachine training data finalized...
## Now building bartMachine for regression...
## evaluating in sample data...done
```

```
# dbarts
set.seed(100)
dB <- bart(x.train = iris2[,1:4],
```

```
            y.train = iris2[,5],
            ntree = 20,
            keeptrees = TRUE,
            nskip = 250,
            ndpost = 1000
)
```

```
##
## Running BART with binary y
##
## number of trees: 20
## number of chains: 1, number of threads 1
## tree thinning rate: 1
## Prior:
##  k prior fixed to 2.000000
##  power and base for tree prior: 2.000000 0.950000
##  use quantiles for rule cut points: false
##  proposal probabilities: birth/death 0.50, swap 0.10, change 0.40; birth 0.50
## data:
##  number of training observations: 100
##  number of test observations: 0
##  number of explanatory variables: 4
##
## Cutoff rules c in x<=c vs x>c
## Number of cutoffs: (var: number of possible c):
## (1: 100) (2: 100) (3: 100) (4: 100)
## offsets:
##  reg : 0.00 0.00 0.00 0.00 0.00
## Running mcmc loop:
## iteration: 100 (of 1000)
## iteration: 200 (of 1000)
## iteration: 300 (of 1000)
## iteration: 400 (of 1000)
## iteration: 500 (of 1000)
## iteration: 600 (of 1000)
## iteration: 700 (of 1000)
## iteration: 800 (of 1000)
## iteration: 900 (of 1000)
## iteration: 1000 (of 1000)
## total seconds in loop: 0.110276
##
## Tree sizes, last iteration:
## [1] 2 3 2 2 2 2 2 2 2 3 2 2 2 4 2 2 2 2
## 2 2
##
## Variable Usage, last iteration (var:count):
## (1: 2) (2: 6) (3: 5) (4: 11)
## DONE BART
```

Create dataframe of trees

```
bmDF <- extractTreeData(model = bm, data = iris2)
dbDF <- extractTreeData(model = dB, data = iris2)
```

Visualisations for Iris example:

Figure 2:

```
vimpPlot(bmDF, plotType = 'pointGrad', metric = 'median')
```

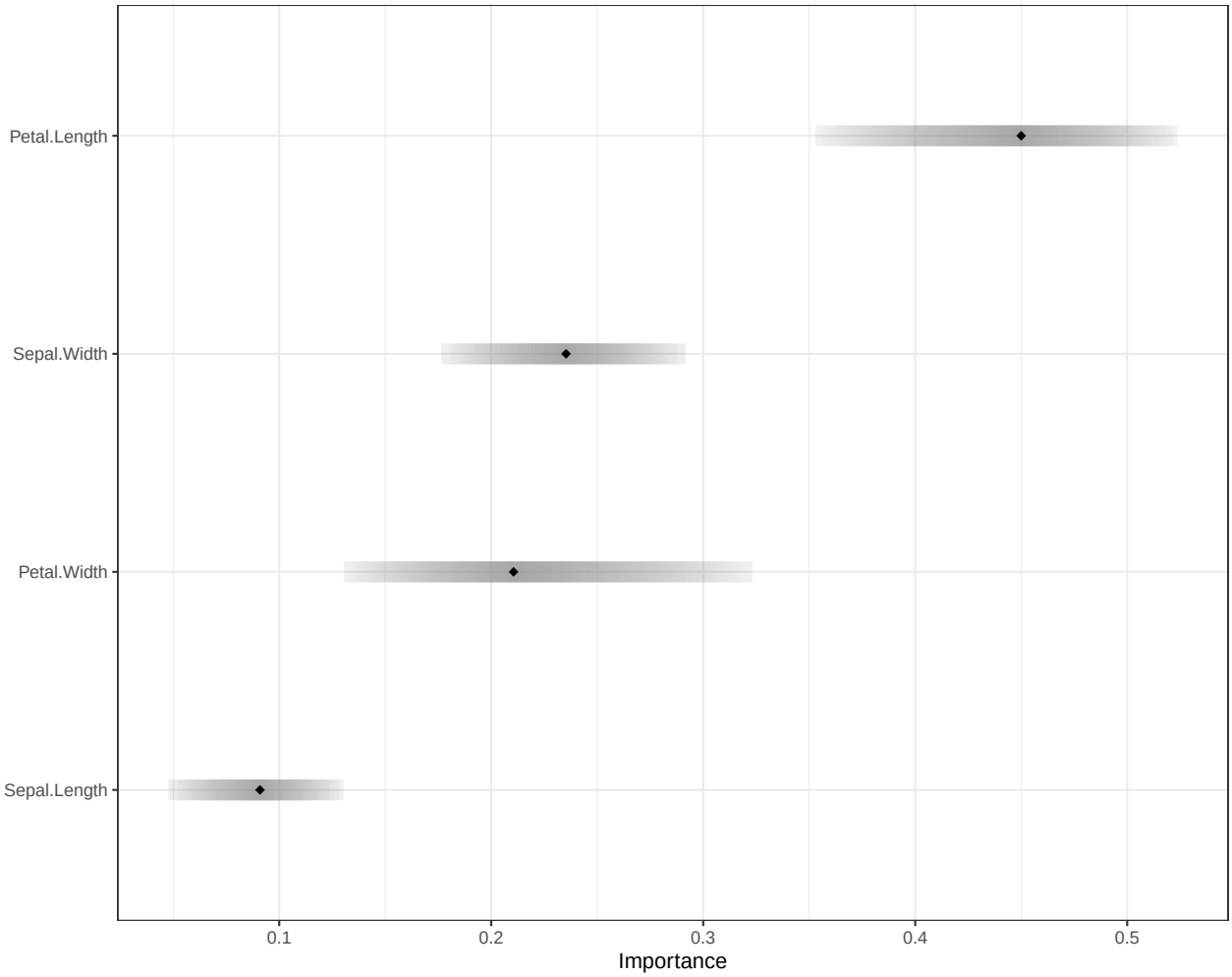
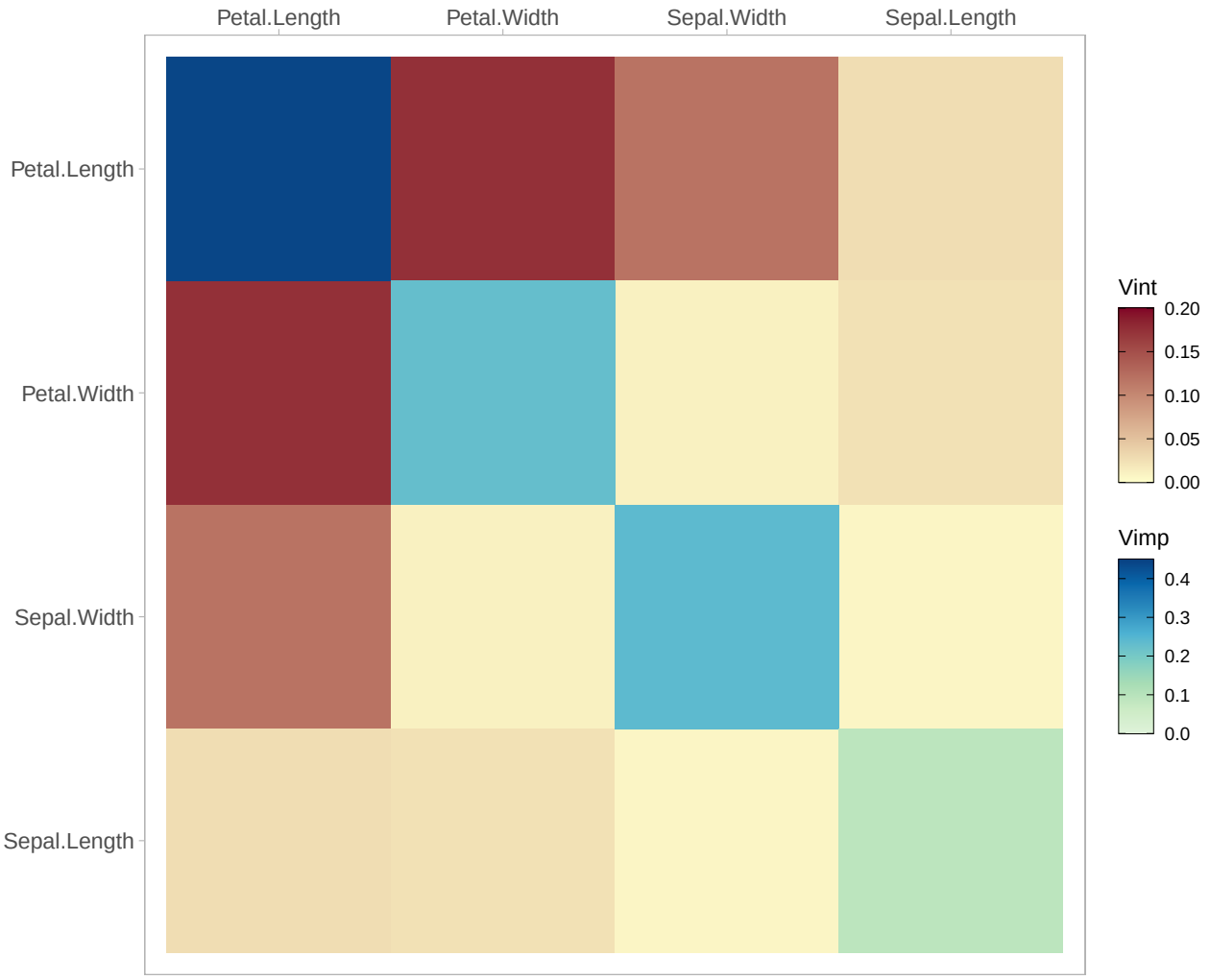


Figure 3:

```
# Set the colors (Need to automate this!!!)
colors <- scales::colour_ramp(
  colors = c(blue = '#FFFFCC', red = '#800026')
)((0:7)/7)

newCols <- RColorBrewer::brewer.pal(9, 'GnBu')
```

```r
colors2 <- newCols[-1]

# create vivi matricies
myMat <- viviBartMatrix(bmDF,
                        type = 'vsup',
                        metric = 'propMean',
                        metricError = "CV")

# plot vivi-heatmap
vivid::viviHeatmap(myMat$actualMatrix,
                   impLims = c(0, 0.45),
                   intPal = colors,
                   impPal = colors2)

# plot vsup-heatmap
viviBartPlot(myMat,
             impLims = c(0,0.45),
             intPal = colors,
             impPal = colors2,
             max_desat = 1,
             pow_desat = 0.6,
             max_light = 0.6,
             pow_light = 1,
             label = 'CV')+
  theme(axis.text.x = element_text(hjust = 0.5))
```


Petal.Length
Petal.Width
Sepal.Width
Sepal.Length
Petal.Length
Petal.Width
Sepal.Width
Sepal.Length
Vint
0.20
0.15
0.10
0.05
0.00
Vimp
0.4
0.3
0.2
0.1
0.0

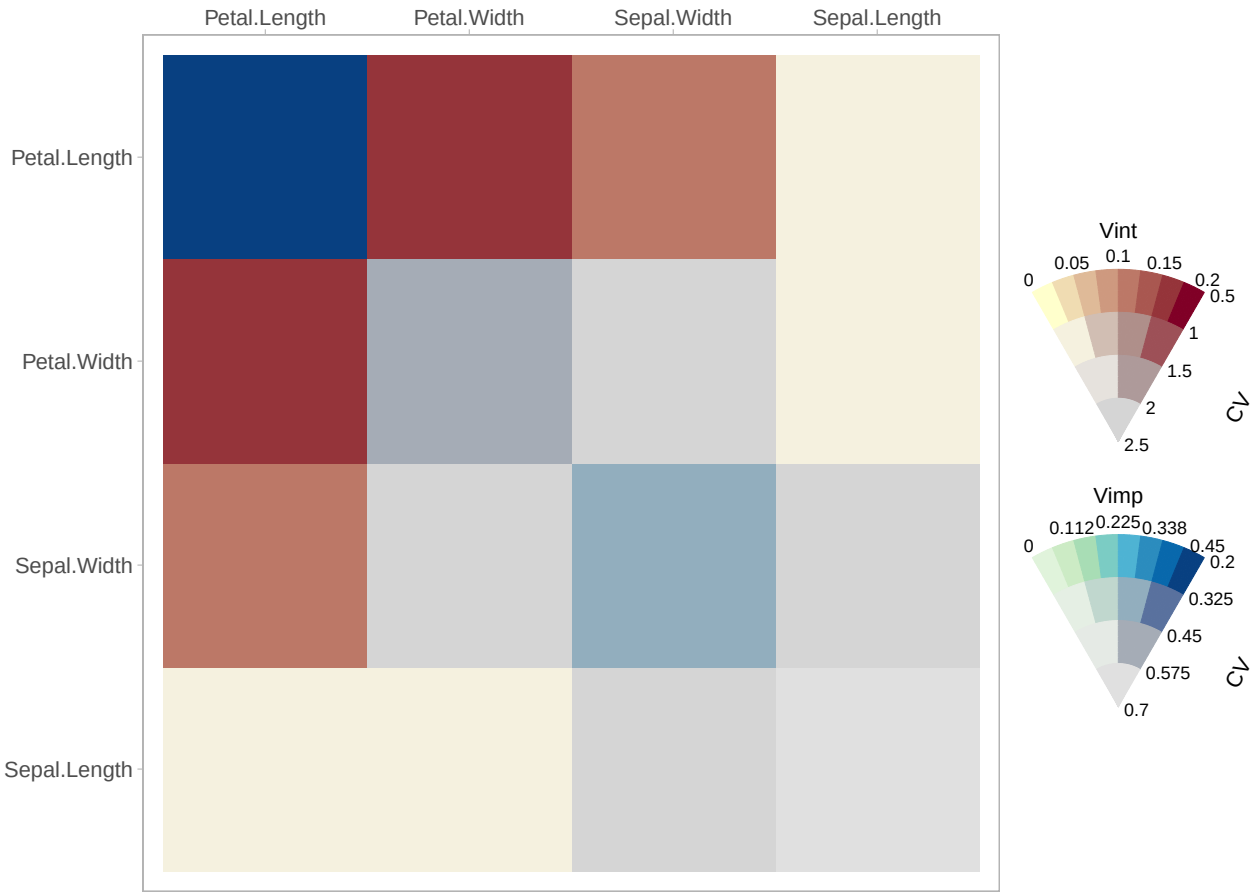


Figure 4:

```
# plot all trees
plotAllTrees(bmDF, treeNo = 20)
```

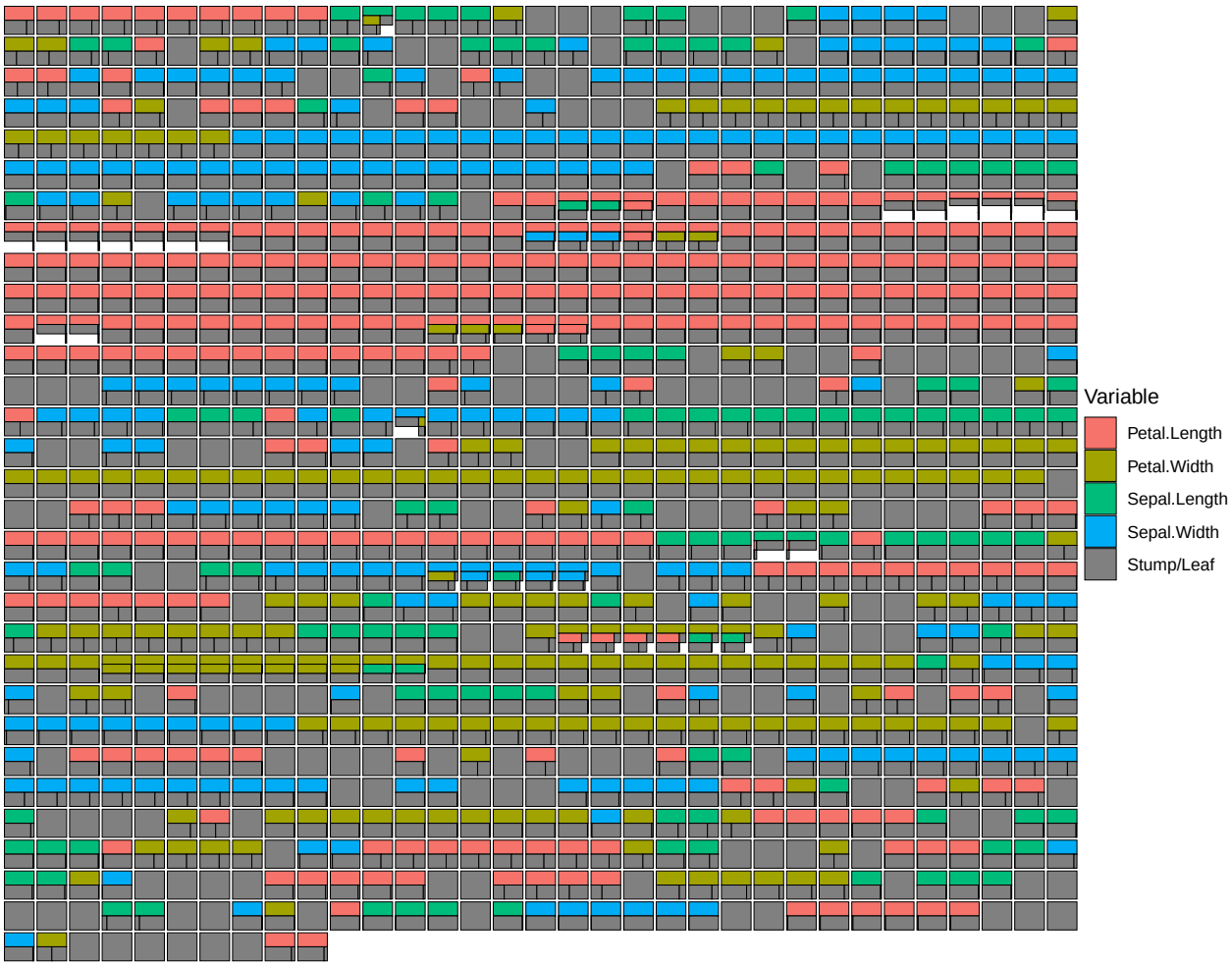
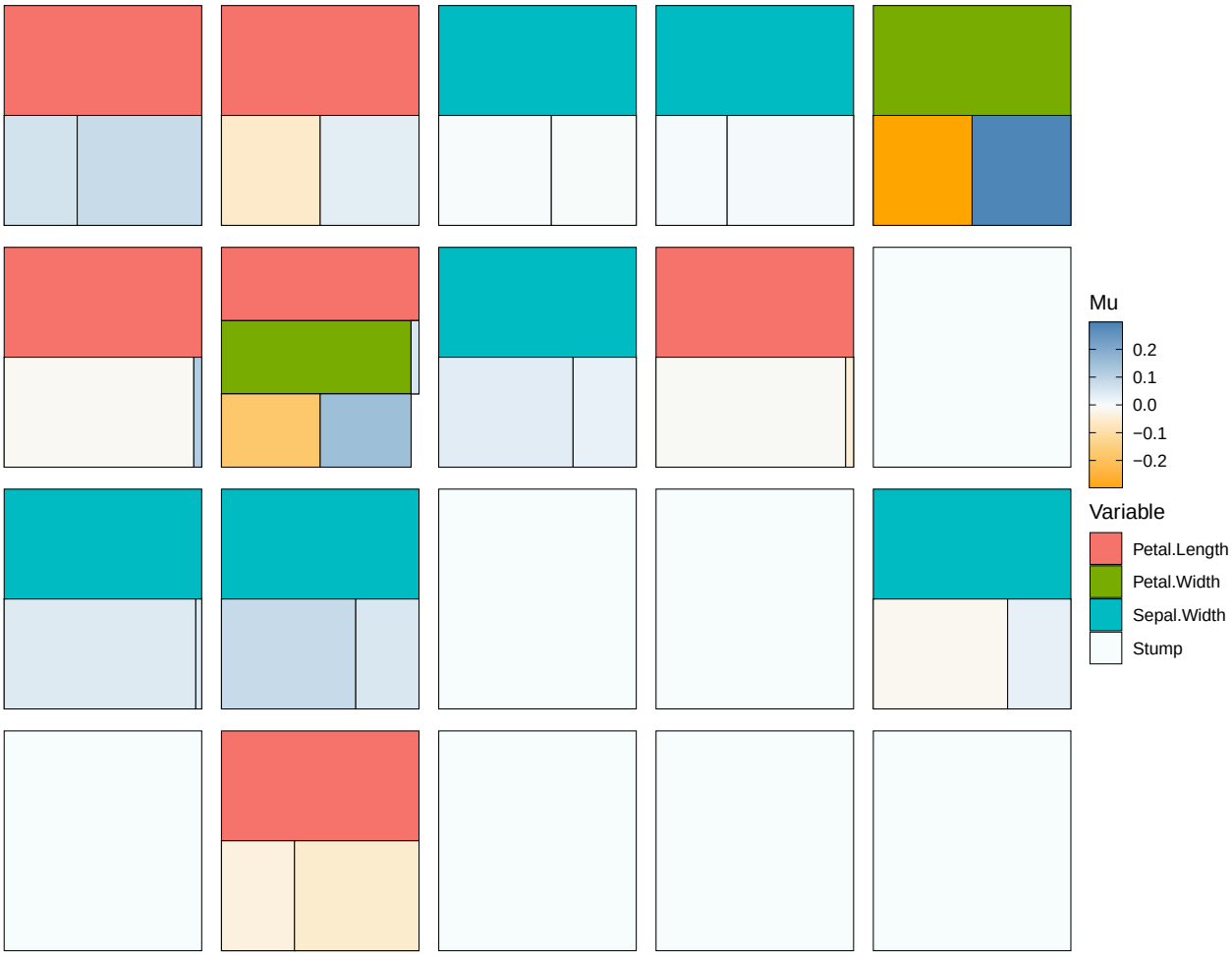
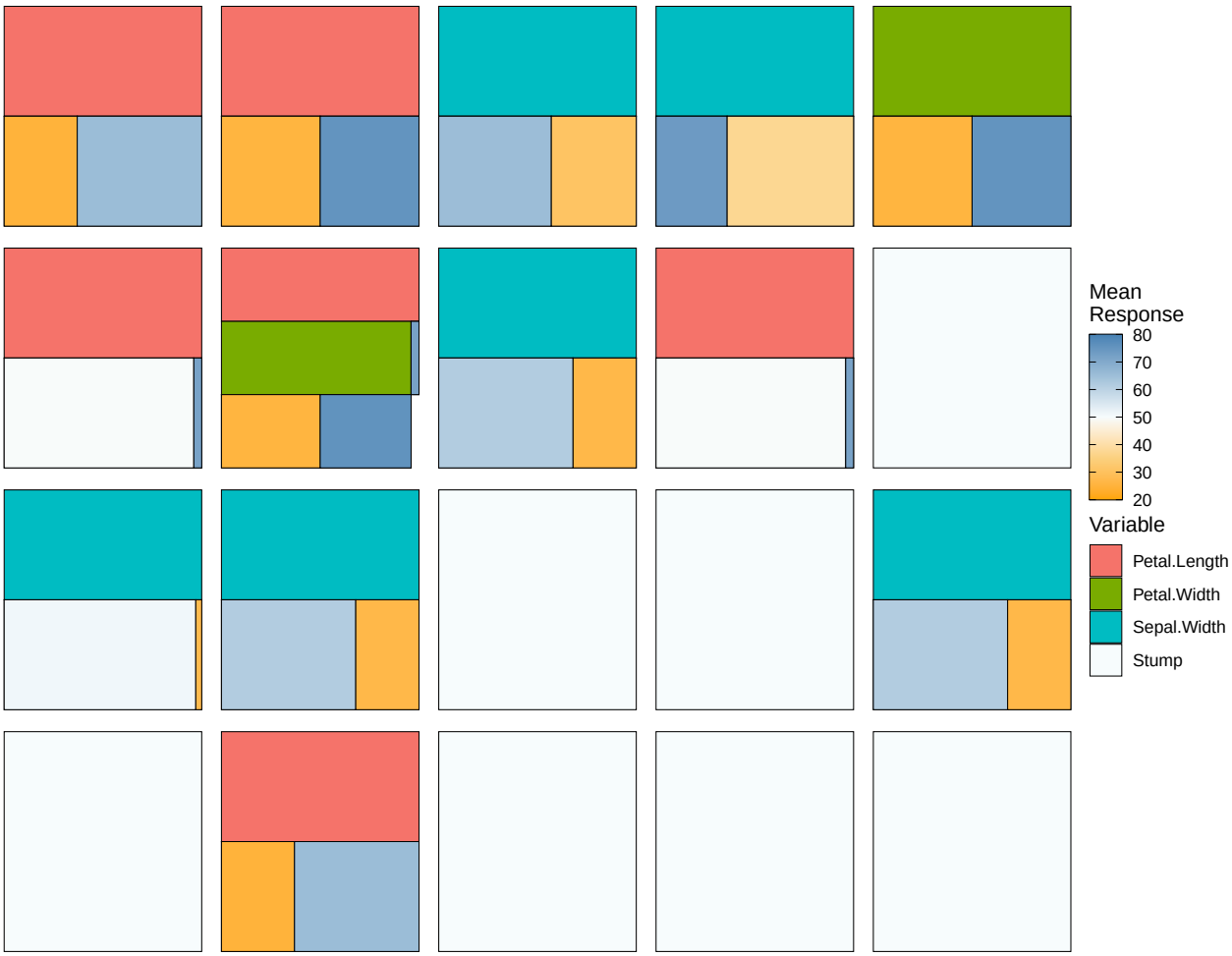
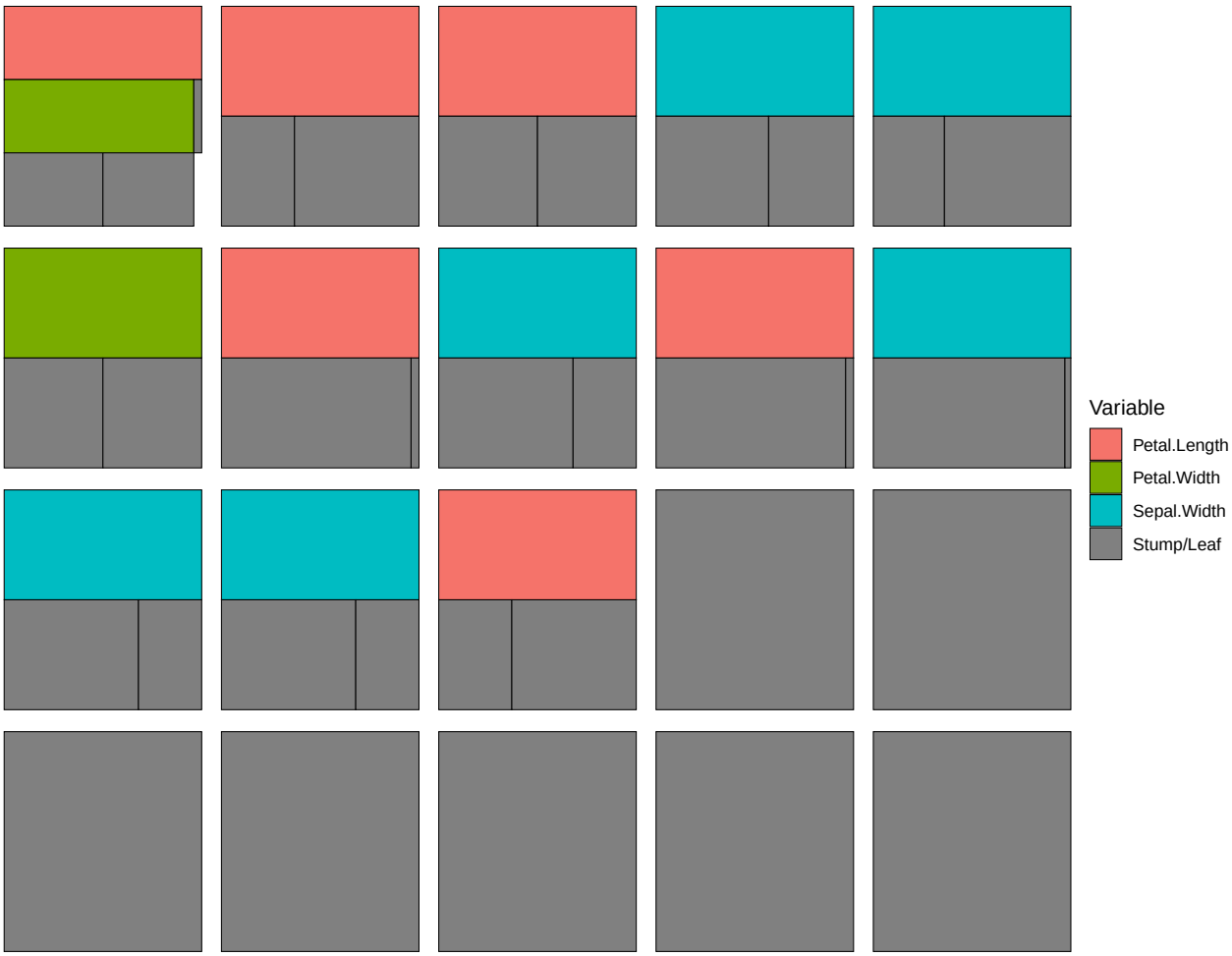


figure 5:

```
# finding iteration with lowest residual sd
bmPost <- bartMachine::bart_machine_get_posterior(bm, iris2[,1:4])

resid = NULL
for(i in 1:1000){
  resid[[i]] <- iris2[,5] - bmPost$y_hat_posterior_samples[,i]
}

finalRes <- lapply(resid, sd)
lowestRes <- which.min(finalRes)

# select palette (need to automate this!!)
mypalette <- rev(colorRampPalette(c('steelblue', '#f7fcfd', 'orange'))(5))

# plot trees from selected iteration
plotAllTrees(bmDF, iter = lowestRes, sizeNode = T, fillBy = 'mu', pal = mypalette)
plotAllTrees(bmDF, iter = lowestRes, sizeNode = T, fillBy = 'response', pal = mypalette)
plotAllTrees(bmDF, iter = lowestRes, cluster = "depth")
plotAllTrees(bmDF, iter = lowestRes, cluster = "var")
```


Mu
0.2
0.1
0.0
−0.1
−0.2
Variable
Petal.Length
Petal.Width
Sepal.Width
Stump


Mean
Response
80
70
60
50
40
30
20
Variable
Petal.Length
Petal.Width
Sepal.Width
Stump


Variable
Petal.Length
Petal.Width
Sepal.Width
Stump/Leaf

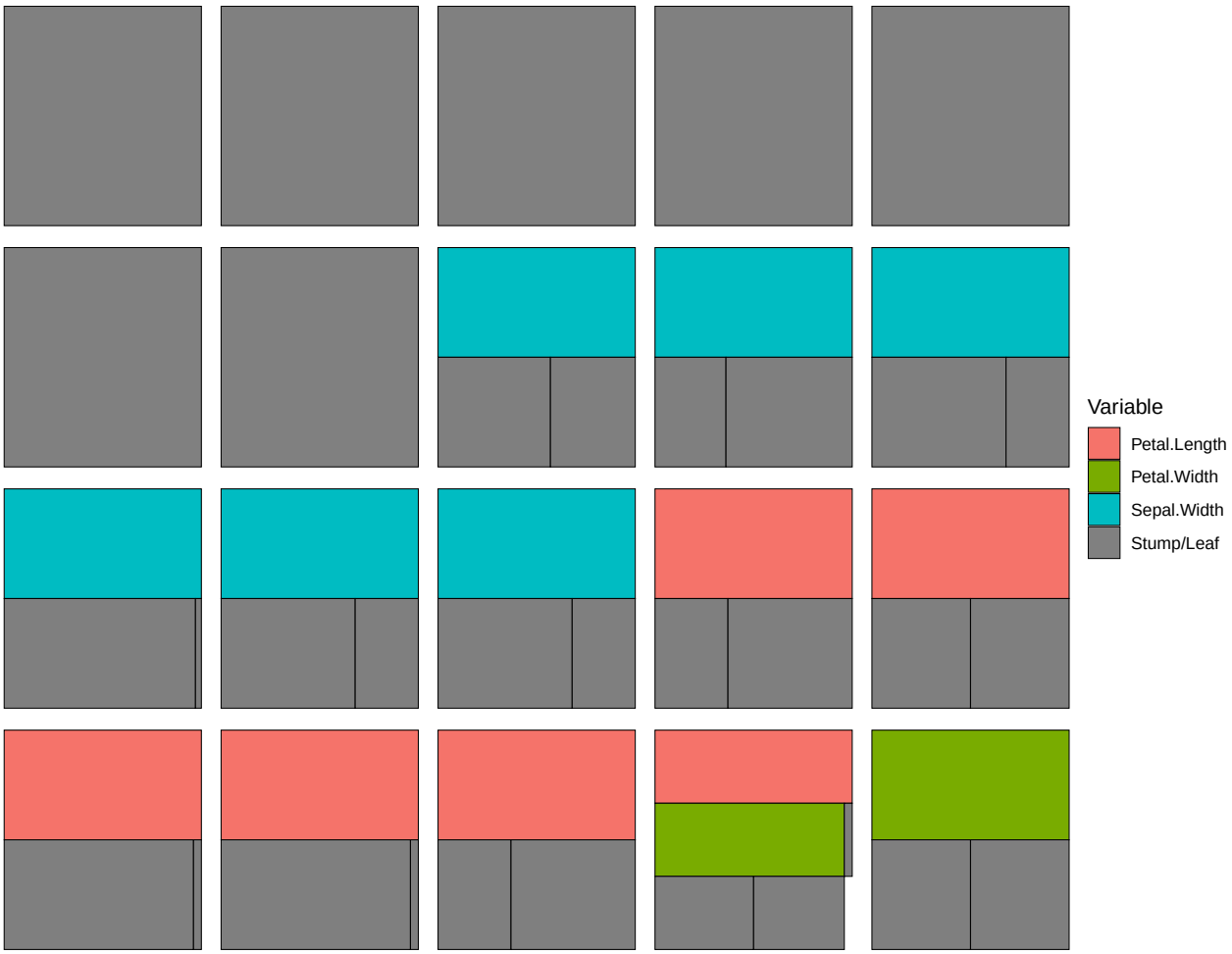


Figure 6:

```
# tree barplot
treeBarPlot(treeData = bmDF, topTrees = 10)
```

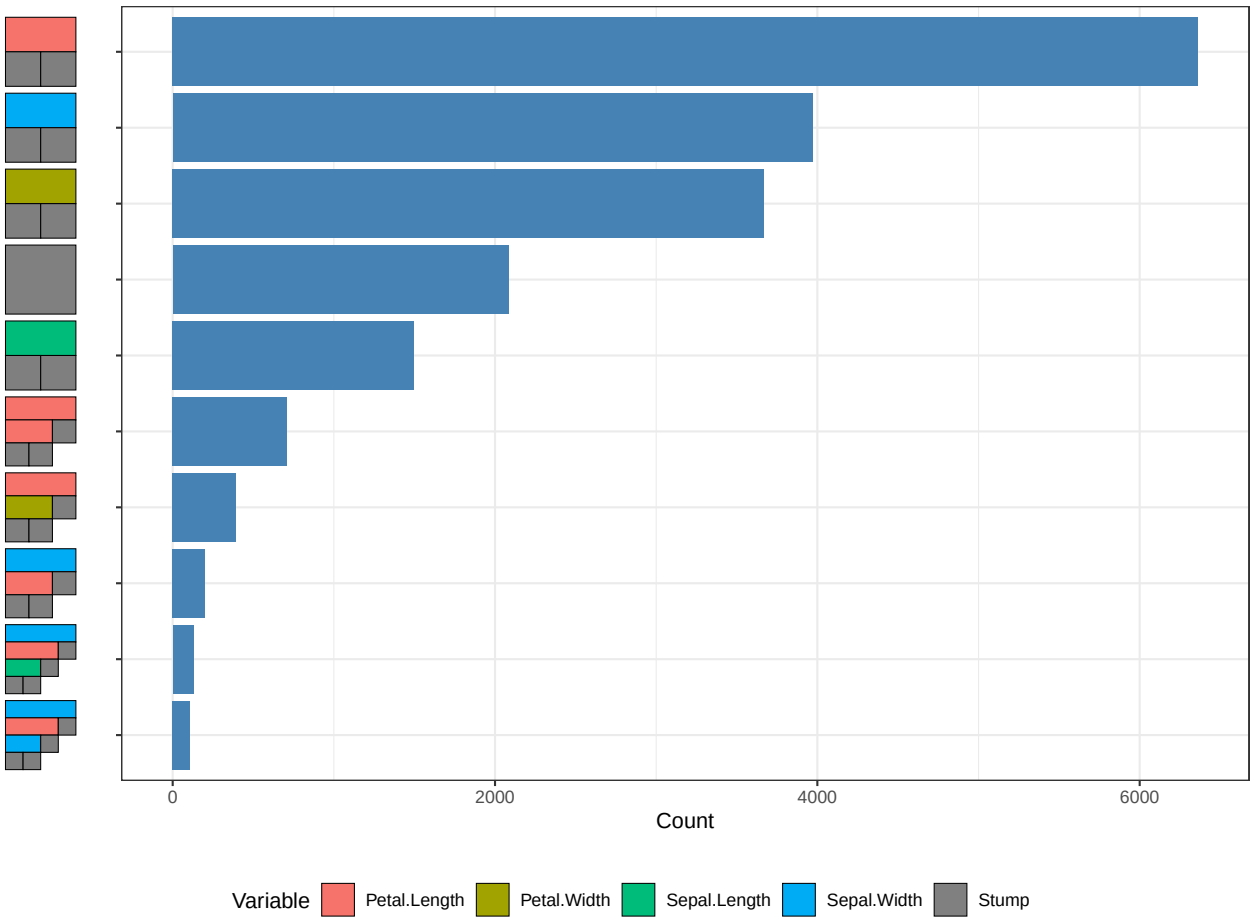
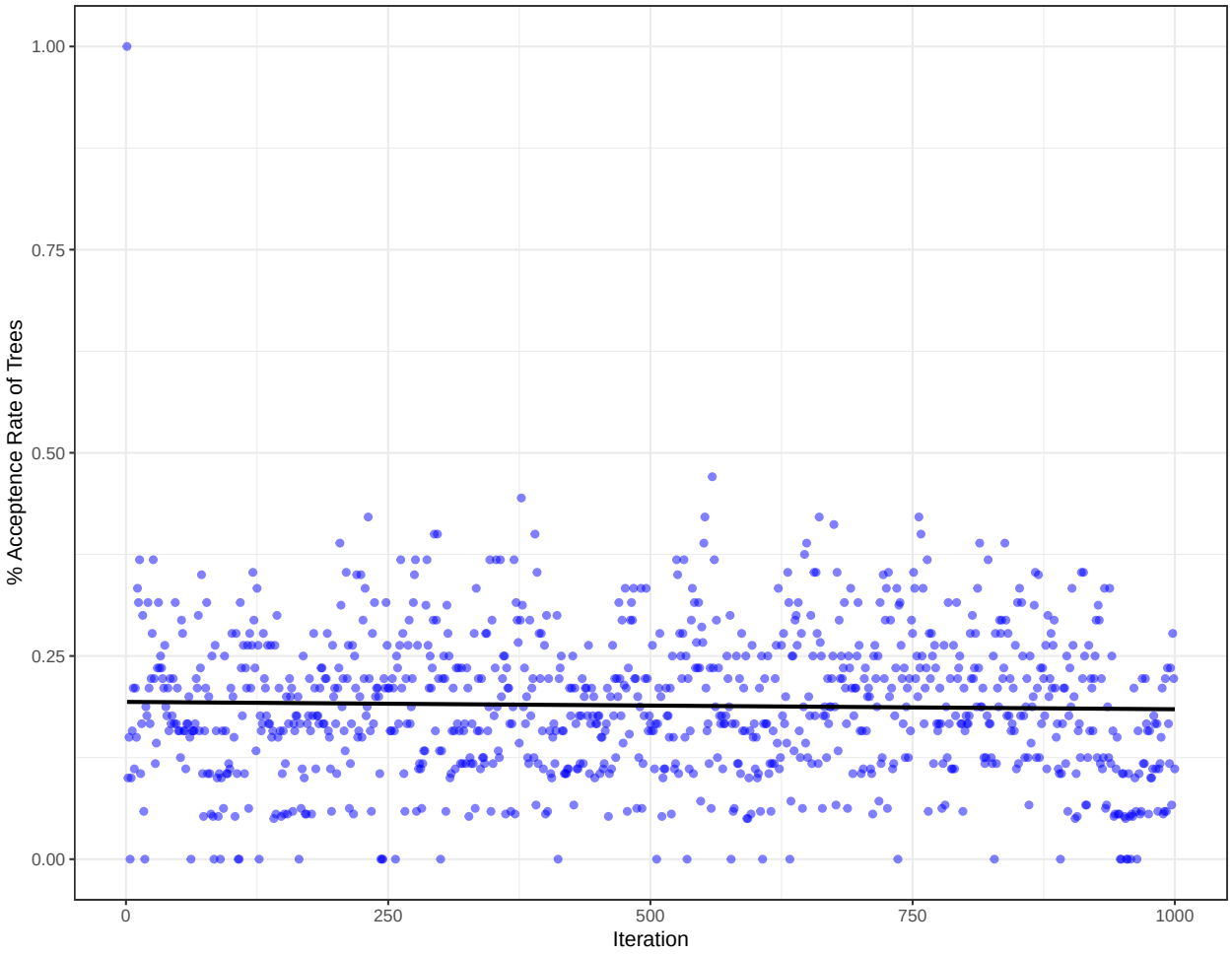


Figure 7:

```
# first get target proximity matrix
bmProx <- proximityMatrix(bmDF, iris2, reorder = T, normalize = T, iter = 736)
# plot MDS
mdsBart(treeData = bmDF, data = iris2, target =  bmProx,
        plotType = 'interactive', showGroup = F)
```

Figure 8:

```
# acceptance rate (setting limits to be equal)
acceptRate(treeData = bmDF) + ylim(c(0, 1))
acceptRate(treeData = dbDF) + ylim(c(0, 1))
```


1.00
0.75
0.50
0.25
0.00
% Acceptence Rate of Trees
0
250
500
750
1000
Iteration

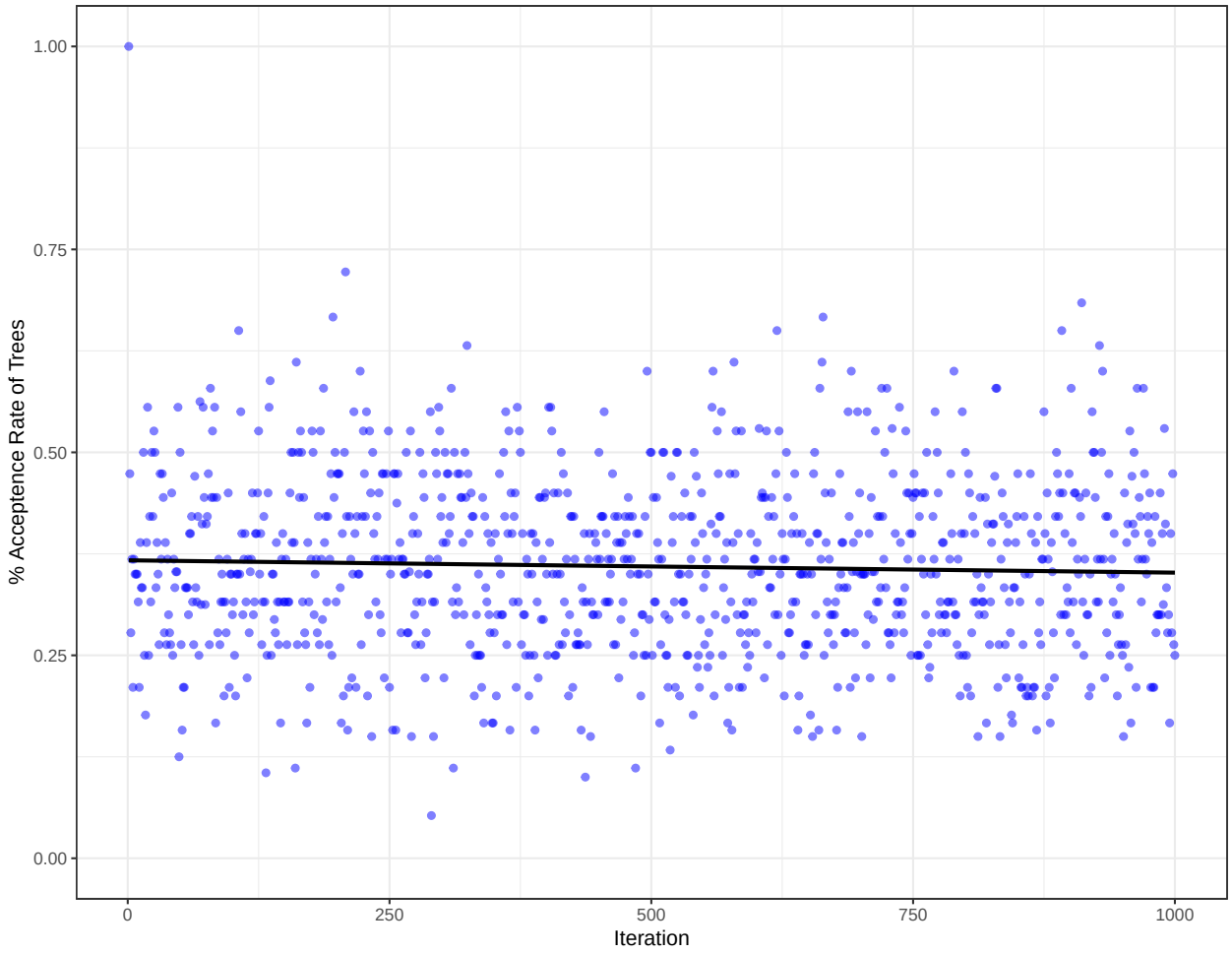
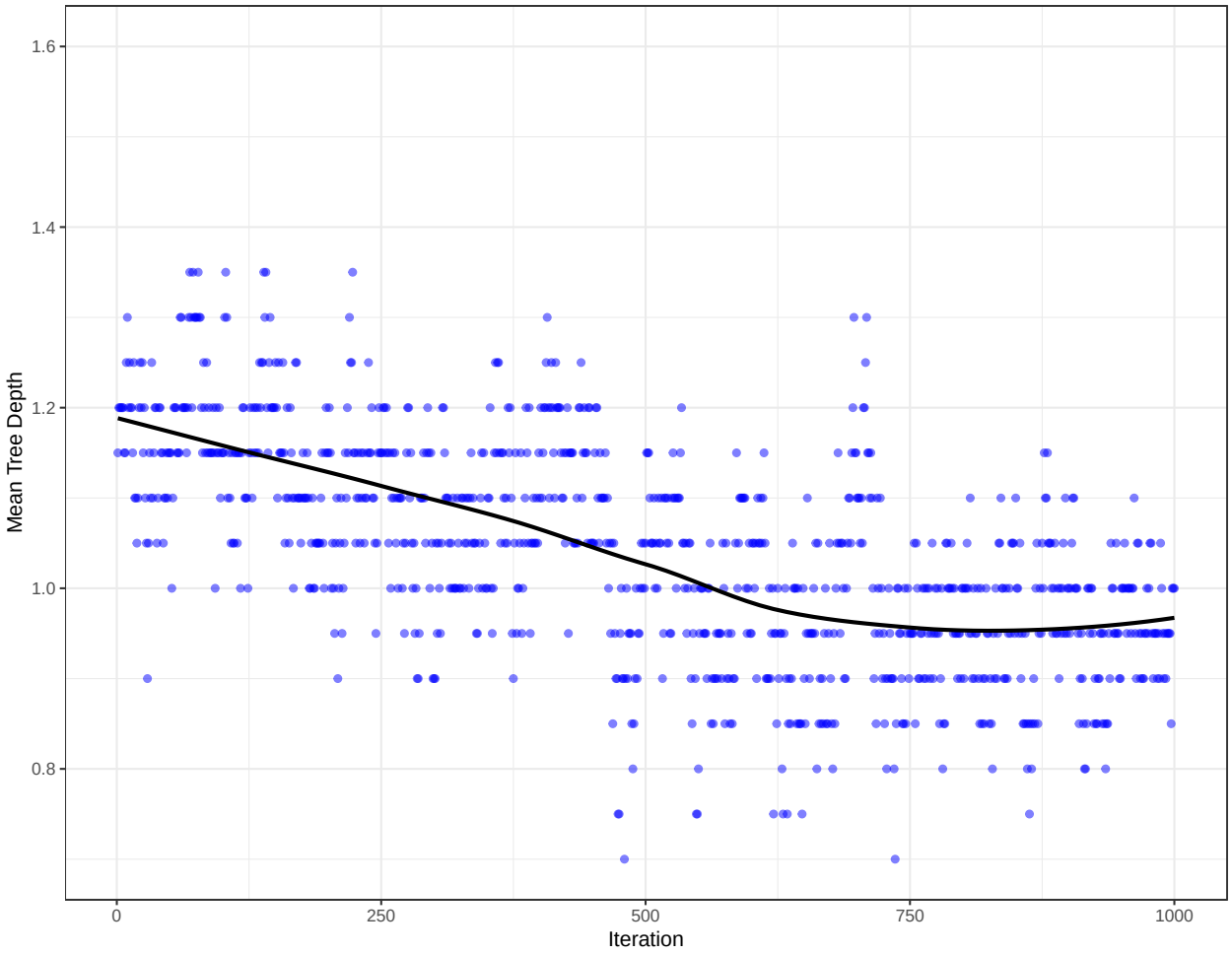
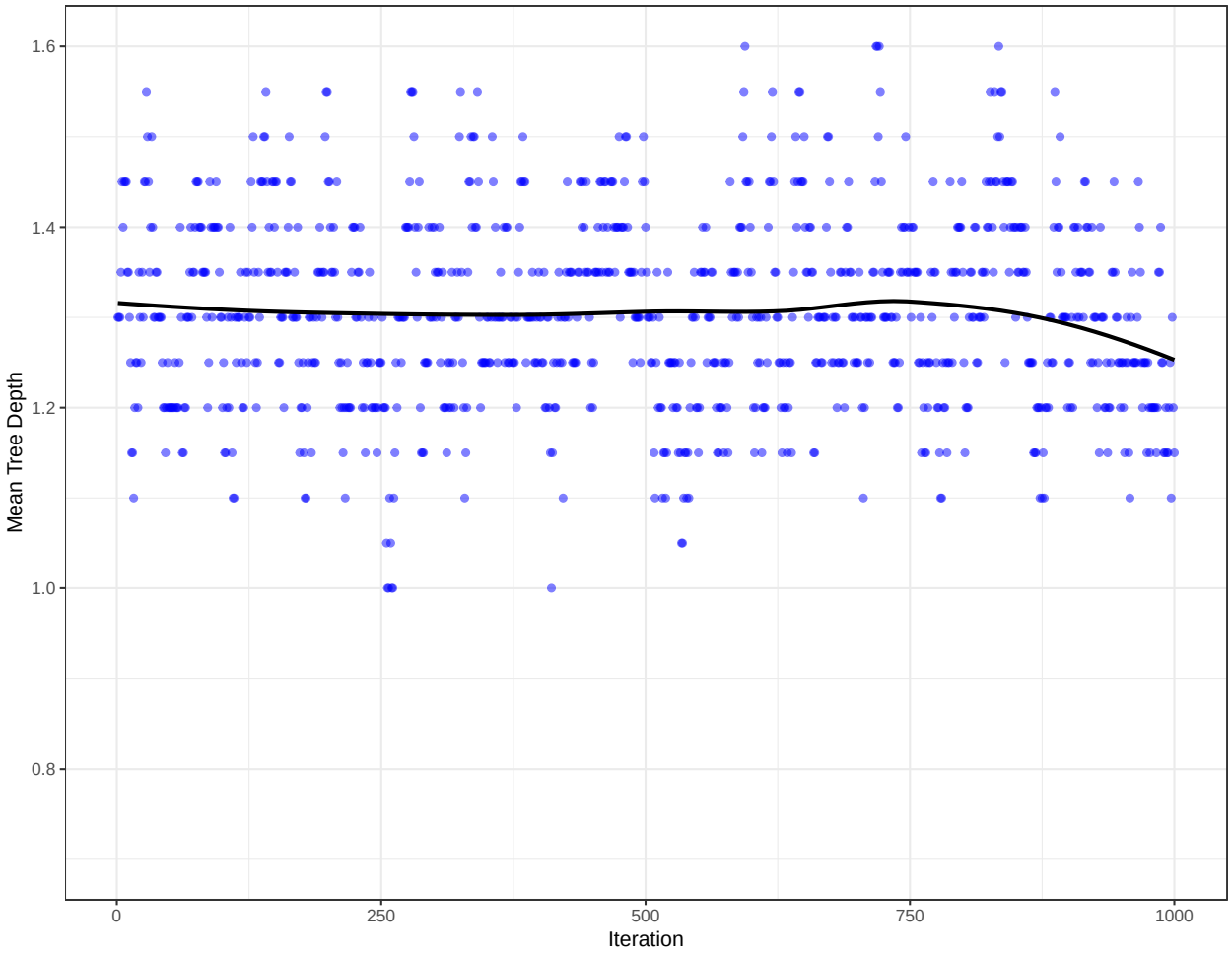
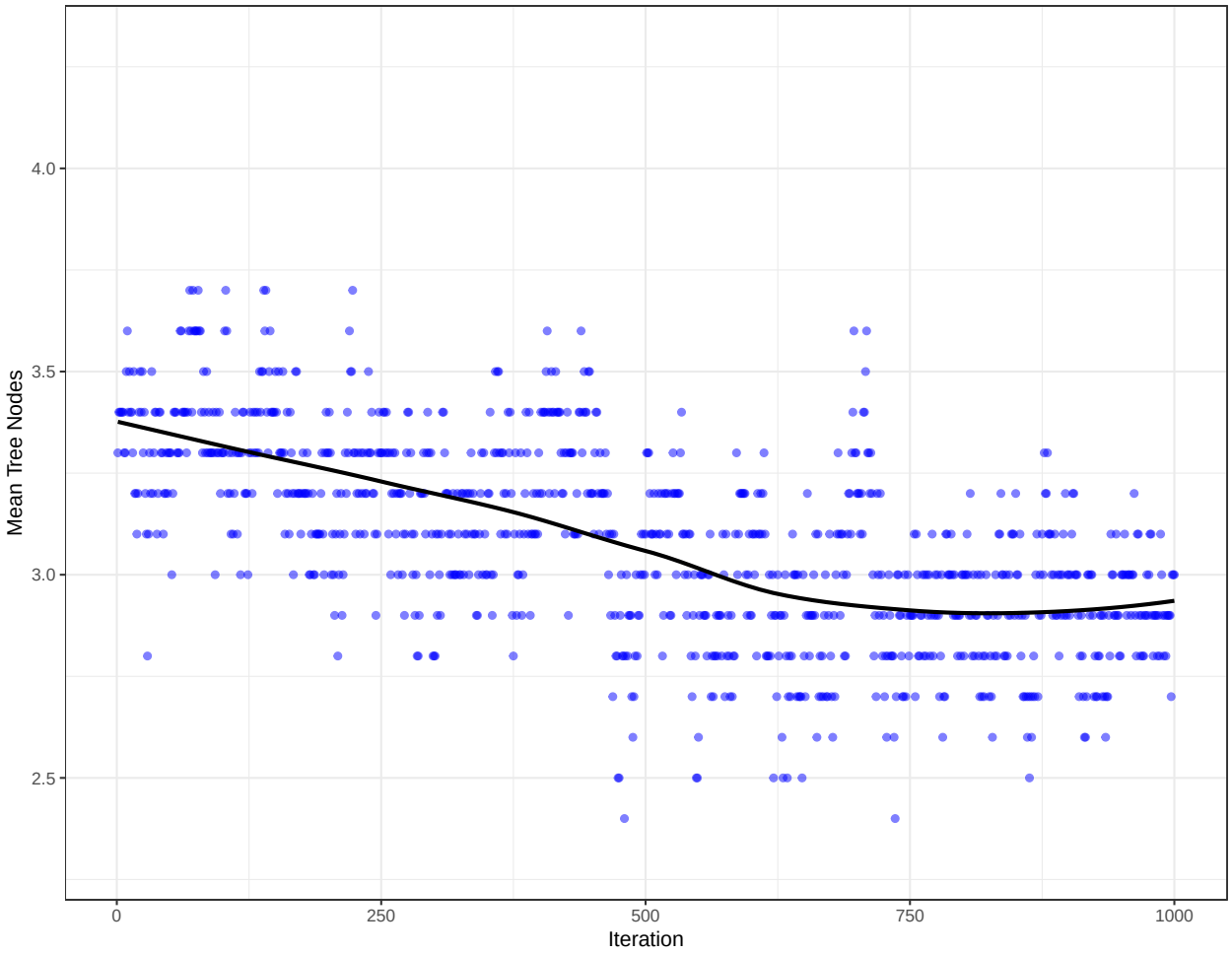


Figure 9:

```
# tree depth per iteration (setting limits to be equal)
treeDepth(bmDF) + ylim(c(0.7, 1.6))
treeDepth(dbDF) + ylim(c(0.7, 1.6))

# tree nodes per iteration (setting limits to be equal)
treeNodes(bmDF) + ylim(c(2.3, 4.3))
treeNodes(dbDF) + ylim(c(2.3, 4.3))
```


Mean Tree Depth
1.6
1.4
1.2
1.0
0.8
0
250
500
750
1000
Iteration


Mean Tree Depth
1.6
1.4
1.2
1.0
0.8
0
250
500
750
1000
Iteration


Mean Tree Nodes
4.0
3.5
3.0
2.5
0
250
500
750
1000
Iteration

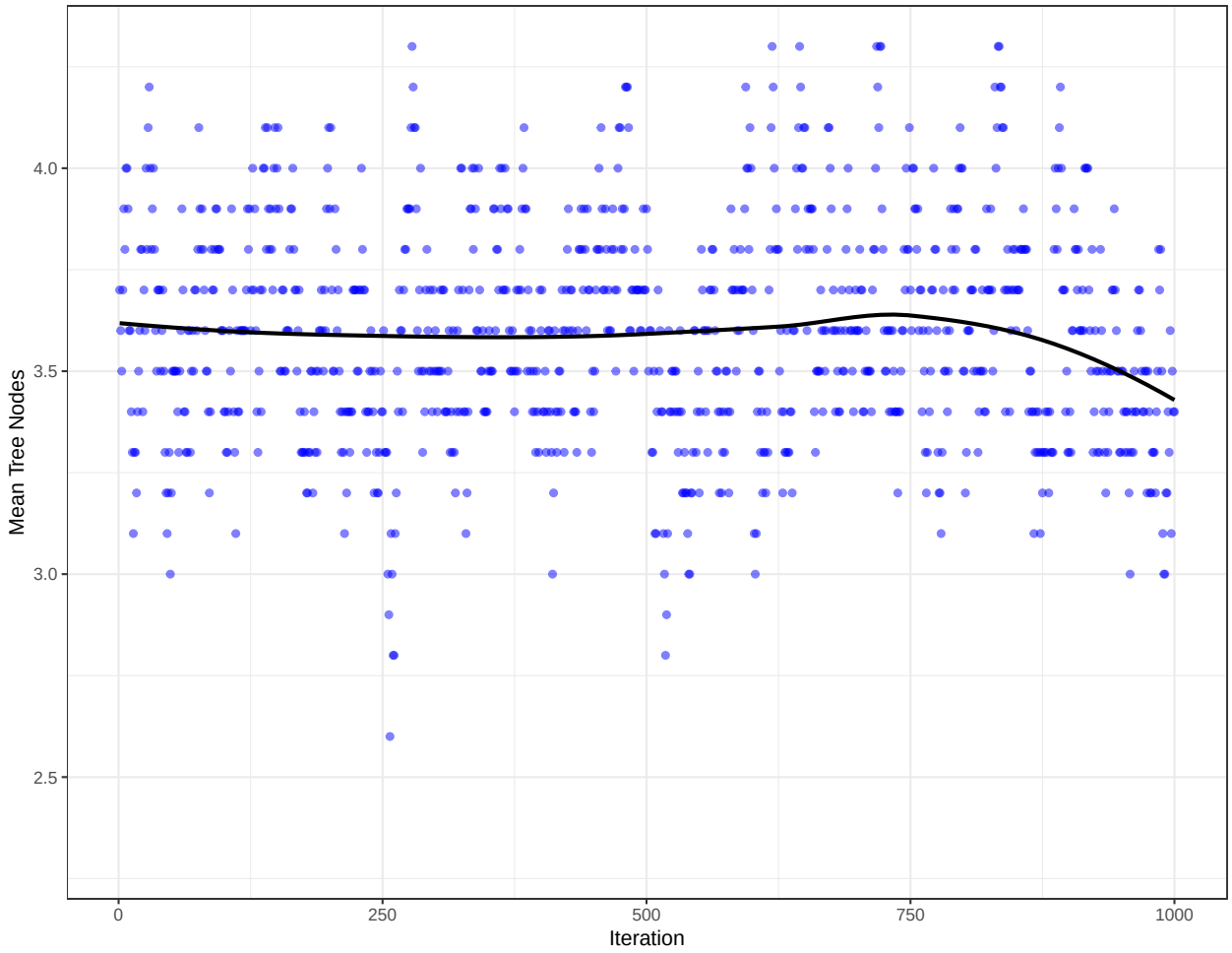
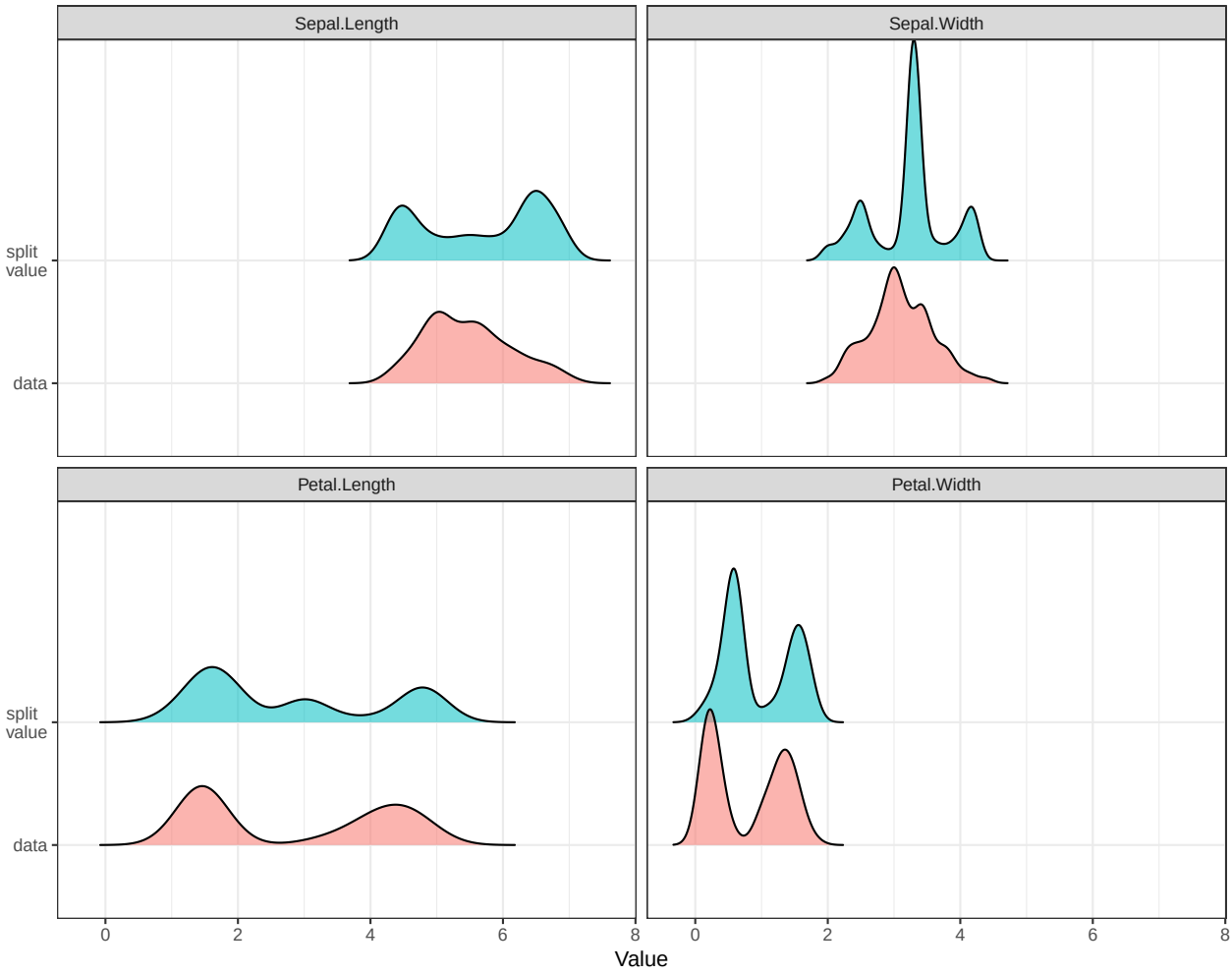
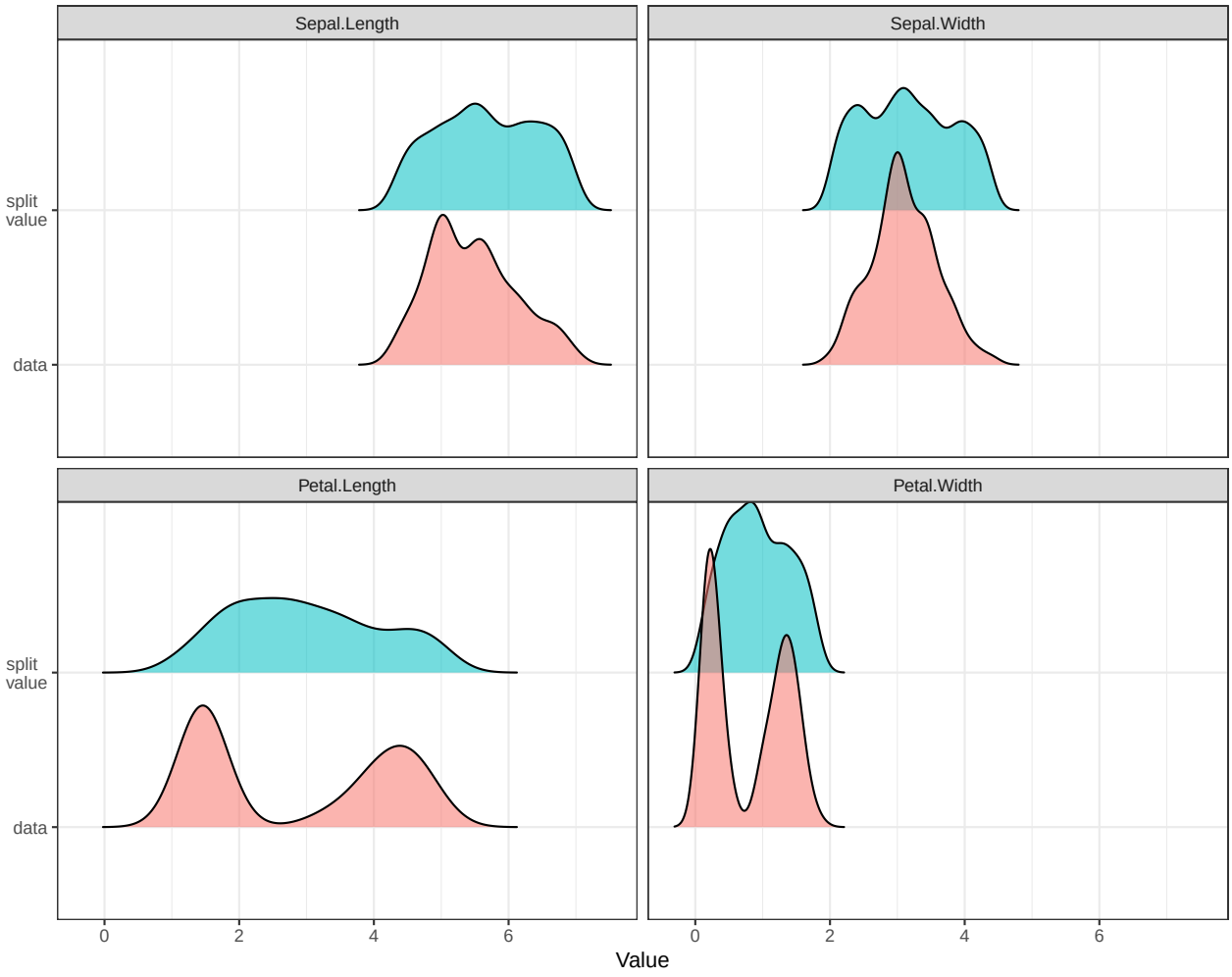


Figure 10:

```
# split density (Need to change both2)
splitDensity(treeData = bmDF, data = iris2, display = 'both2')
splitDensity(dbDF, data = iris2, display = 'both2')
```


Sepal.Length
Sepal.Width
Petal.Length
Petal.Width
split
value
data
0
2
4
6
8
Value


Sepal.Length
Sepal.Width
Petal.Length
Petal.Width
split
value
data
0
2
4
6
Value