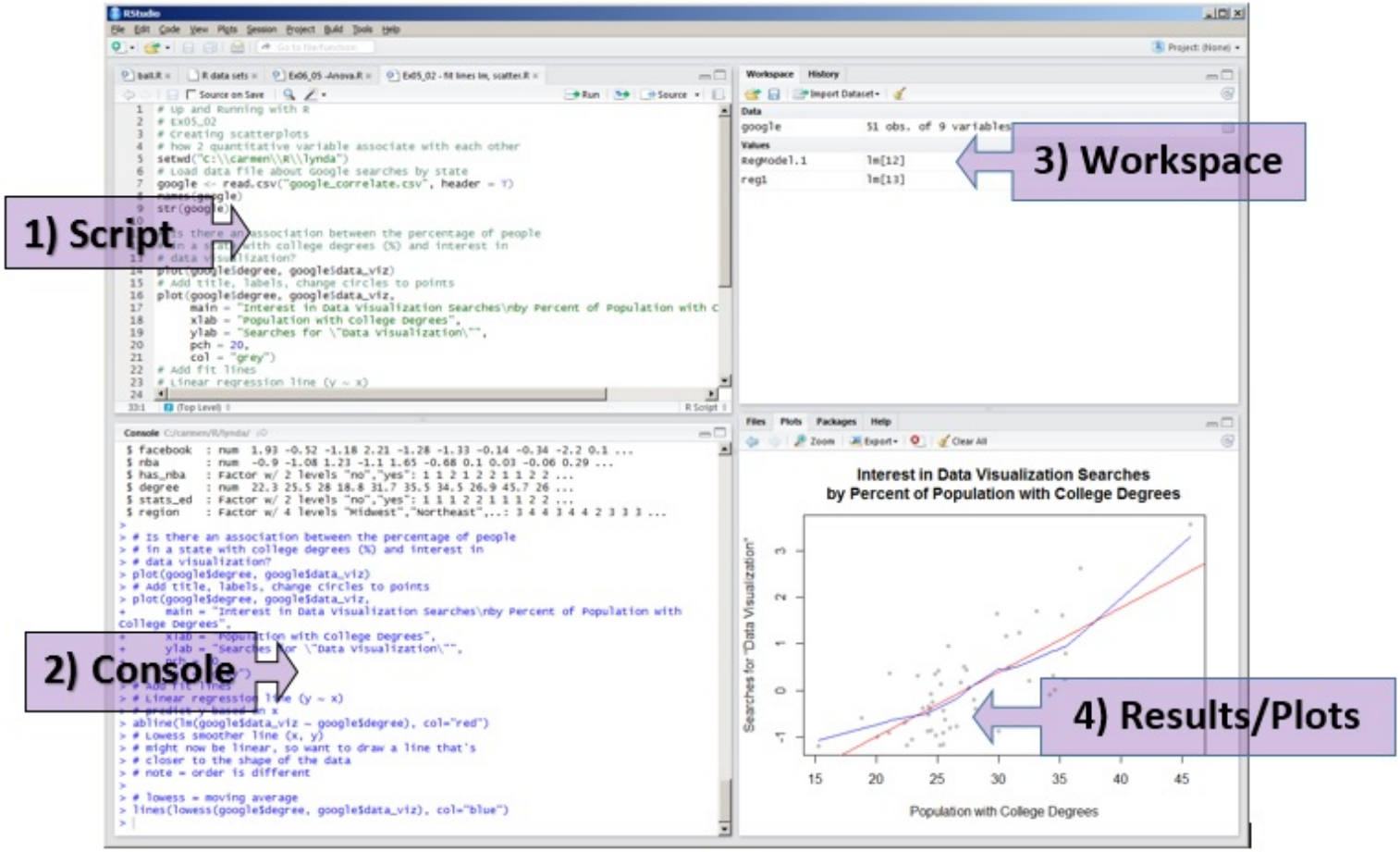
Introduction to R

February 8, 2018

R and RStudio



What R can do

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Everything.[1,2]

1 Except think about your science

2 Occasionally in a non efficient way

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What about RStudio?

Make your life easier
Many handy tricks.

Calculating a mean: Arithmetic and assignment

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  (2 + 3 + 5 + 1) / 4
```

```
[1] 2.75
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  b <- 3
  c <- 5
  d <- 1

  (a + b + c + d) / 4
```

```
[1] 2.75
```

```
  a <- 45
  (a + b + c + d) / 4
```

```
[1] 13.5
```

Calculating a mean: using vectors

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c(2,3,5,1) # c is for concatenate

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 mydata <- (2,3,5,1) # c is missing => error!
```

```
Error: <text>:1:14: unexpected ','
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                ^
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Error:  <text>:1:14:  unexpected ','
1:  mydata <- (2,
                ^
```

Why bother with vectors?

```
  mydata[2] <- 4
  mydata

[1] 2 4 5 1
```

Calculating a mean: using functions

How to use a function?

```
?mean
```

Calculating a mean: using functions

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?mean
```

```
mean(c(2,4,5,1))

[1] 3

mean(mydata)

[1] 3

mean(x = mydata)

[1] 3
```

Loading data

```
data("trees")
```

Loading data

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data("trees")
```

```
str(trees)

'data.frame': 31 obs. of  3 variables:
 $ Girth : num  8.3 8.6 8.8 10.5 10.7 10.8 11 11 11.1 11.2 ...
 $ Height: num  70 65 63 72 81 83 66 75 80 75 ...
 $ Volume: num  10.3 10.3 10.2 16.4 18.8 19.7 15.6 18.2 22.6 19.9 ...
```

Try also `summary`, `class`, `head`, `tail`

Access

Bracket-syntax

- Row: dataframe[row,]
- Column: dataframe[, column]
- Element: dataframe[row, column]

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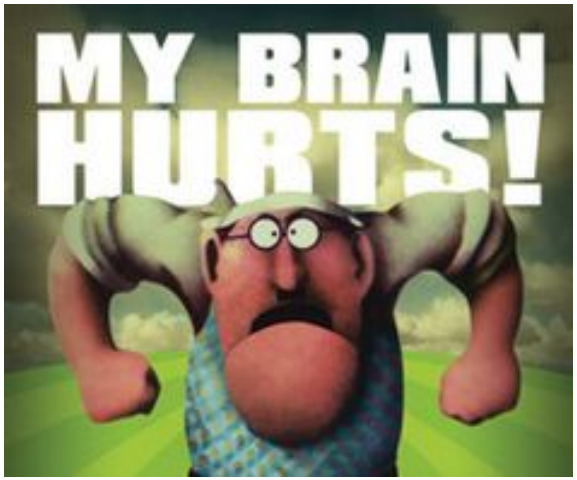
```
trees[,1]
trees[1:8,]
trees[c(2,1,2), 3]
trees[, "Height"]
```

Dollar-syntax

- Column `dataframe$column_name`
- Element `dataframe$column_name[row]`

```
trees$Height
```

Finally time to think a tiny bit!



Calculate the mean for all three variables in trees, excluding the last (31st) record.

How to get the row means?

```
mean(trees[1,])
mean(trees[2,])
mean(trees[...,])
```

How to get the row means?

```
mean(trees[1,])
mean(trees[2,])
mean(trees[...,])
```

:

How to get the row means? For-loops

```
for (i in 1:N)
{
  something as a function of i
}
```

How to get the row means? For-loops

```
  for (i in 1:N)
  {
    something as a function of i
  }
```

```
ResultMean <- vector() # we will store the results there
for (i in 1:31)
{
  ResultMean[i] <- mean(as.numeric(trees[i,]))
}
```

For-loops: your turn!

Load Sunspots data.

```
data("rock")
```

Use a for loop to obtain column averages

More concise alternative: apply functions

```
apply(X = dataframe, MARGIN = 1 (row) or 2 (col), FUN = function)
```

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```
apply(X = dataframe, MARGIN = 1 (row) or 2 (col), FUN = function)
```

```
apply(X = rock, MARGIN = 1, FUN = mean)#by row (not meaningful)
apply(X = rock, MARGIN = 2, FUN = mean)#by column
```

Even better (worse)...

```
colMeans(rock)
rowMeans(rock)
```

Even better (worse)...

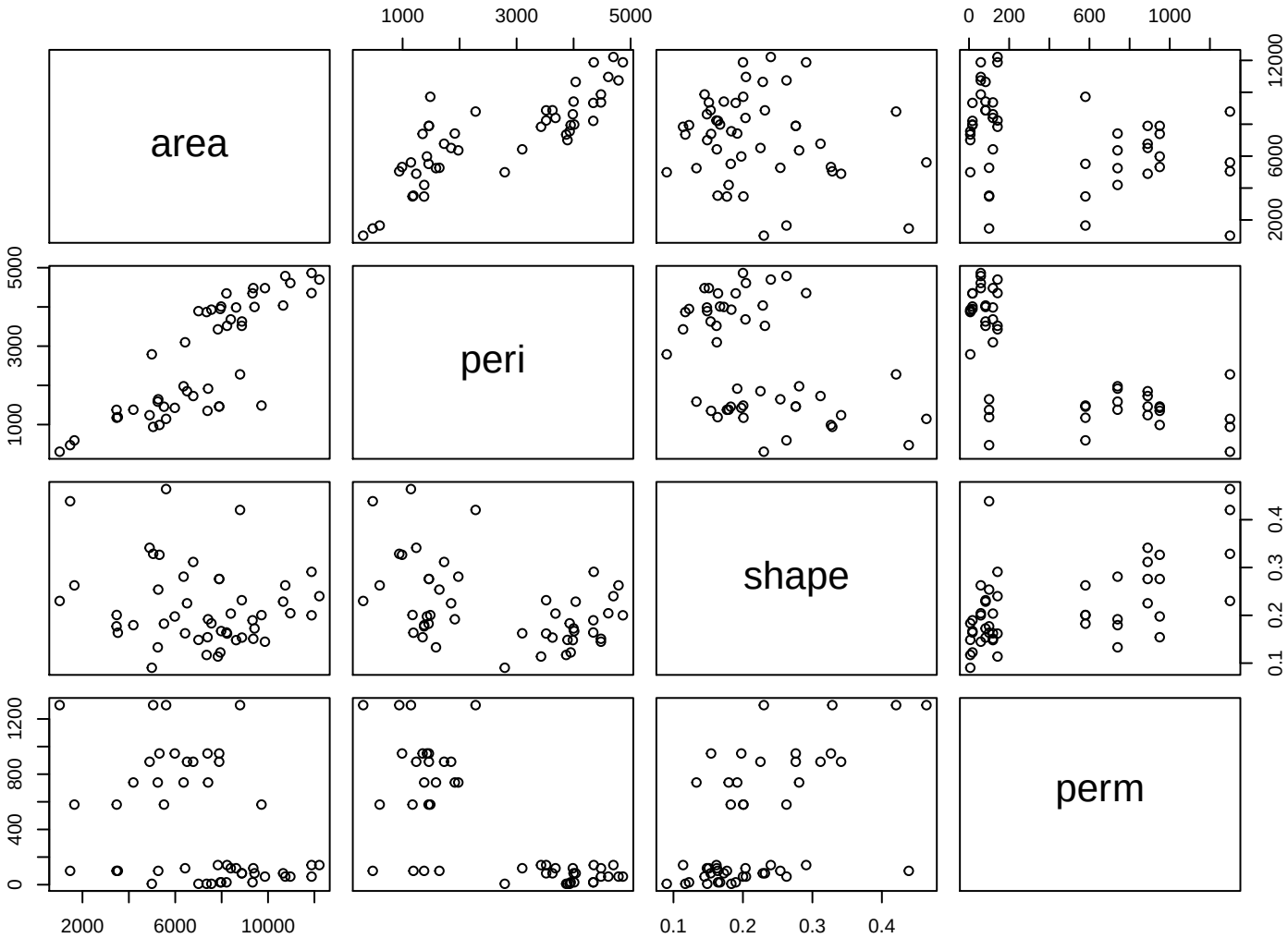
```
colMeans(rock)
rowMeans(rock)
```

Trade-off concision / flexibility

- colMeans shortest, but does only means
- apply very flexible, but does only array/matrix/data-frame
- for-loop looks complex, but infinitely flexible
- (NB: your computer does a for-loop whether you see it or not)

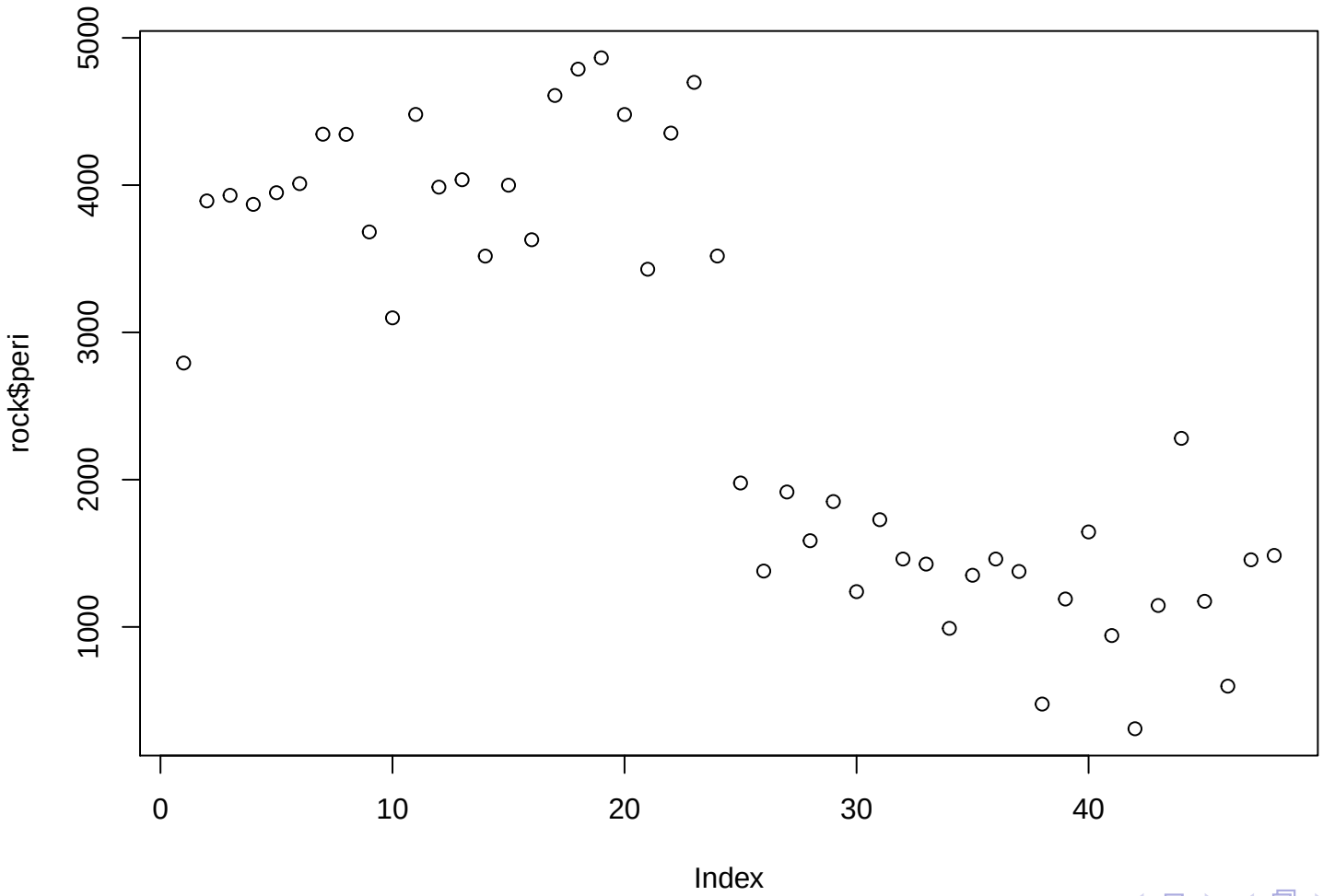
plot function

```
plot(rock)
```



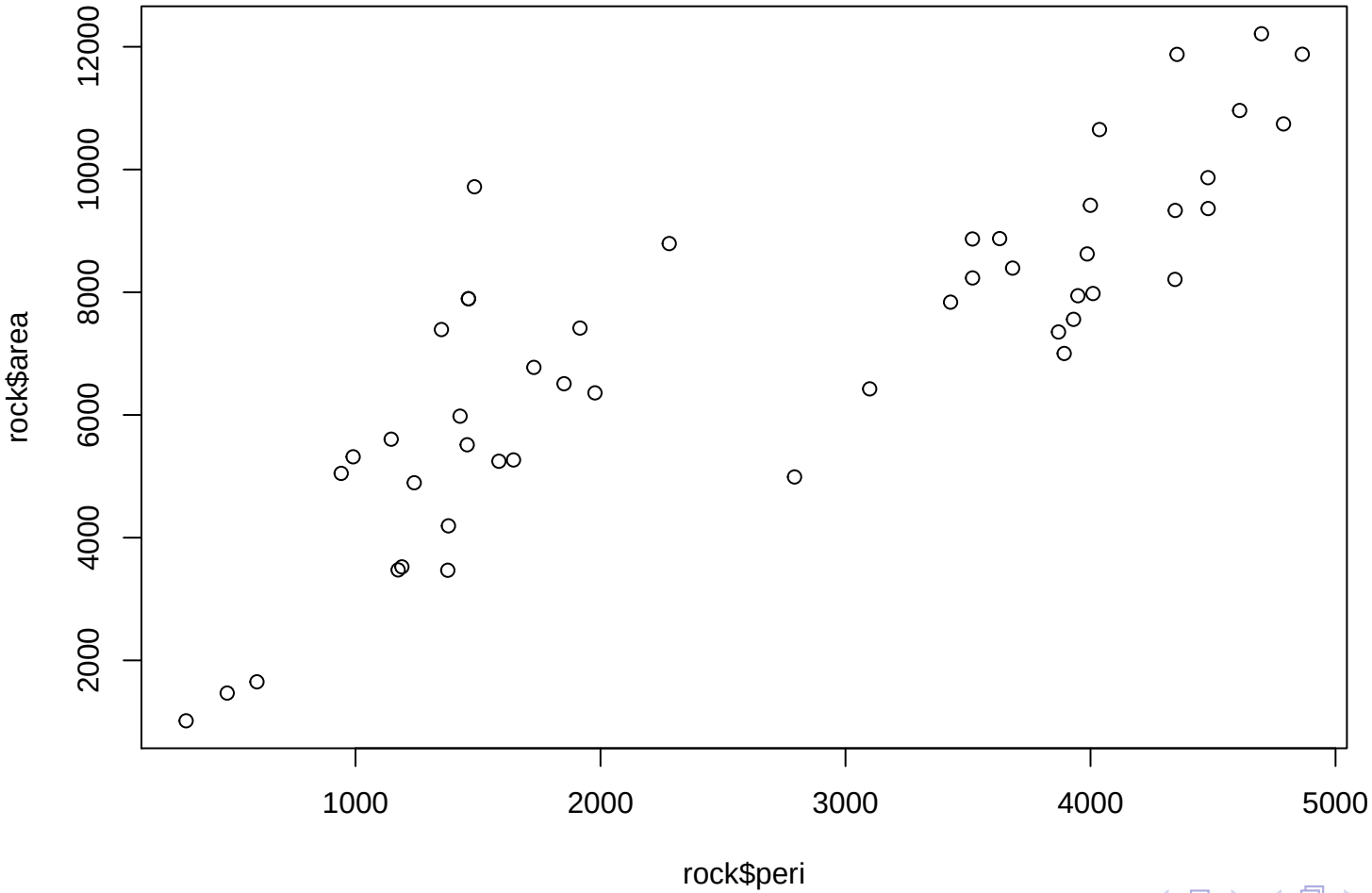
plot function

```
plot(rock$peri)
```



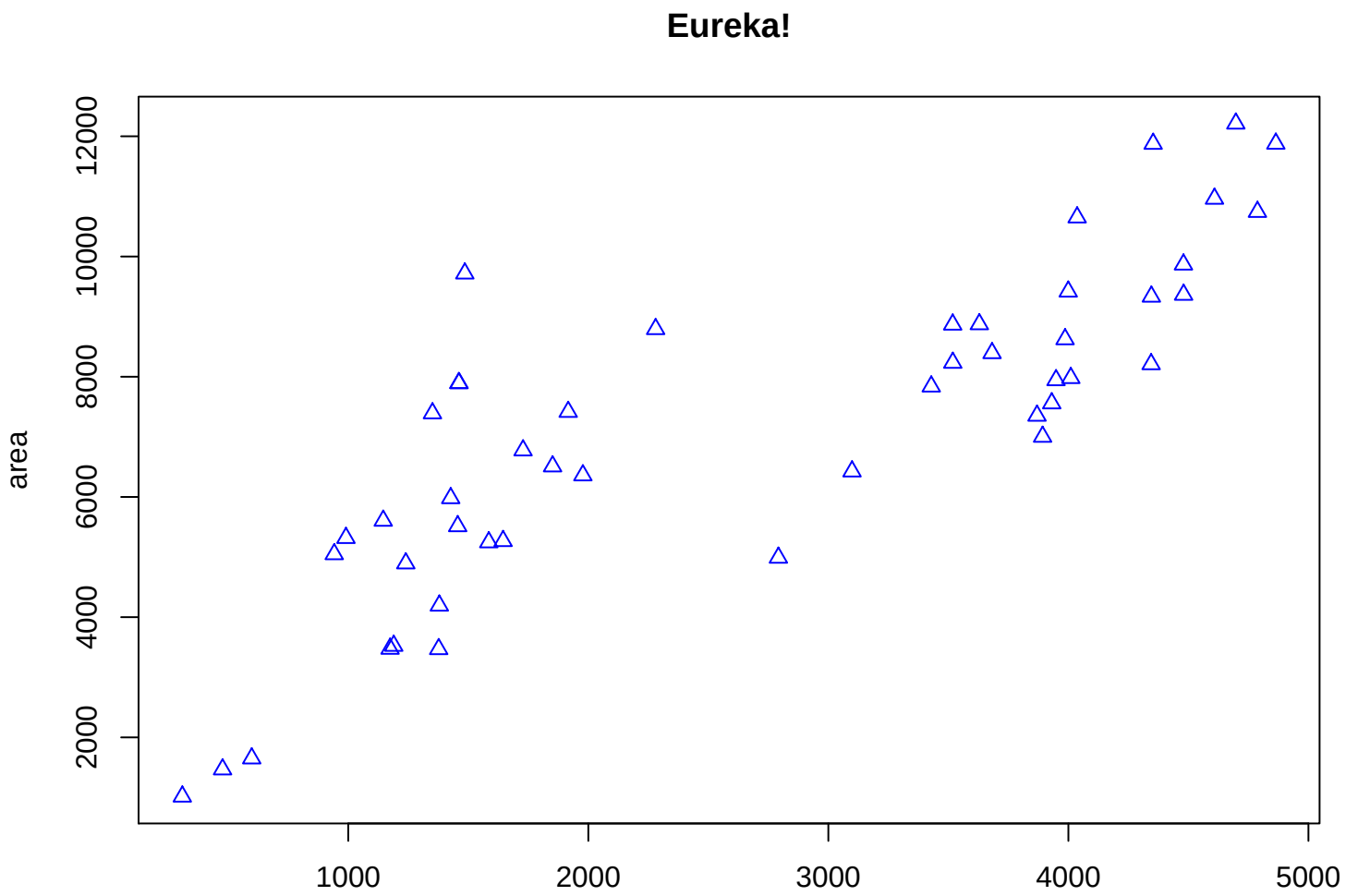
plot function

```
plot(x = rock$peri, y = rock$area)
```



plot function

```
plot(x = rock$peri, y = rock$area, main = "Eureka!",
     xlab = "Perimeter", ylab = "area", col="blue", pch=2)
```

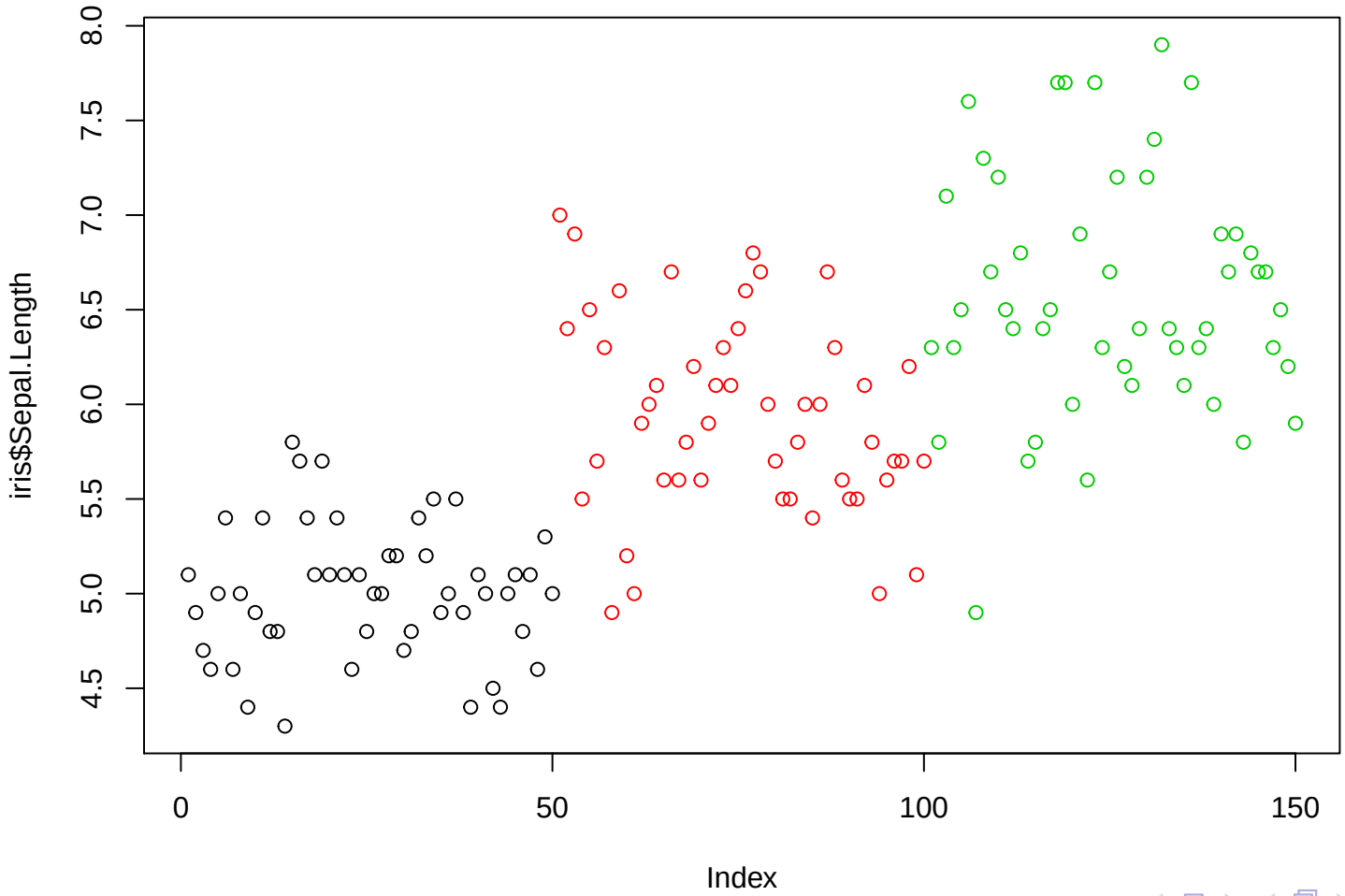


plot function: back to the mean

```
data("iris")
```

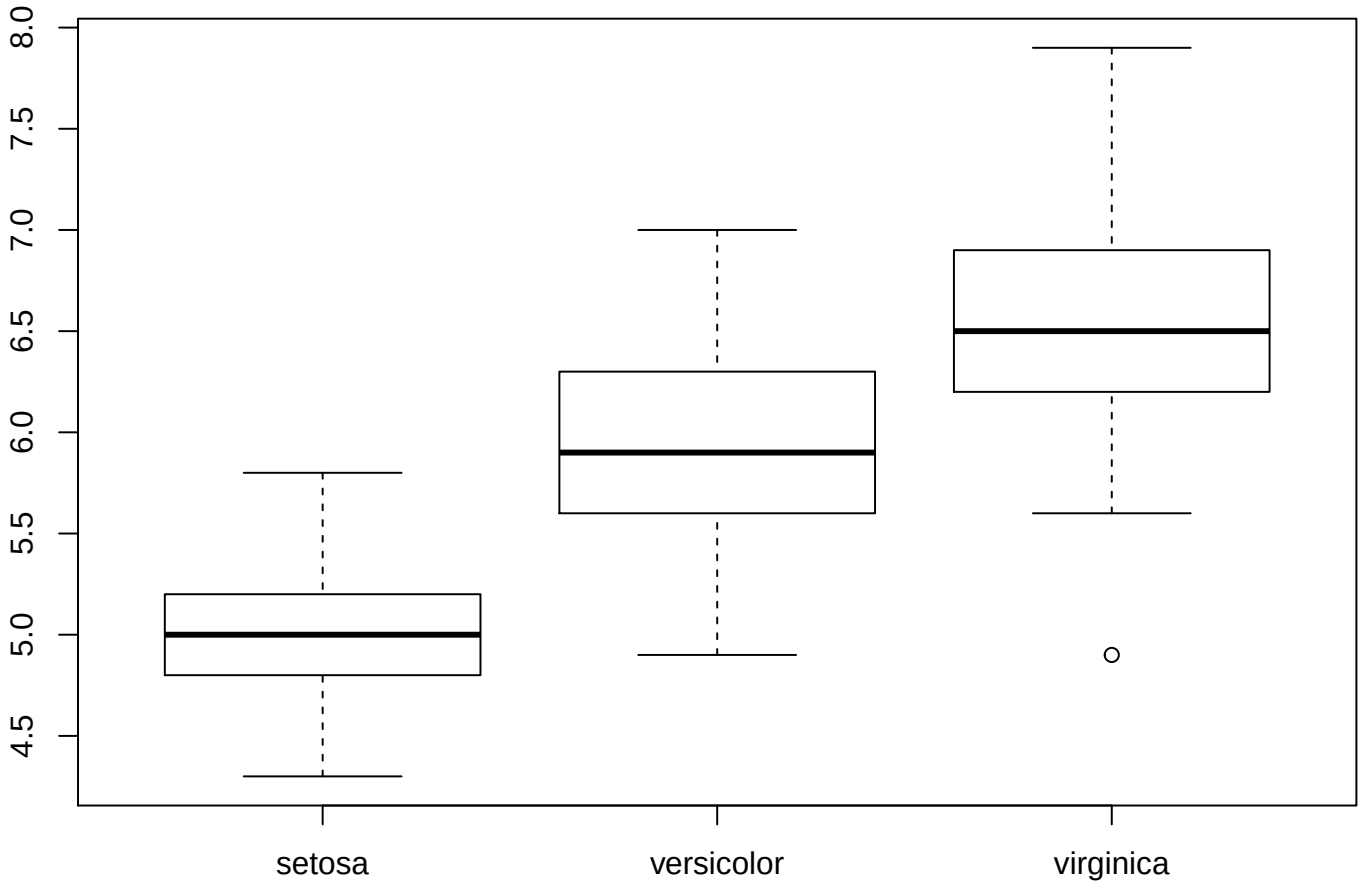
plot function: back to the mean

```
plot(iris$Sepal.Length, col=iris$Species)
```



boxplots

```
boxplot(iris$Sepal.Length ~ iris$Species)
```



Student's T.test introduction

```
?t.test
```

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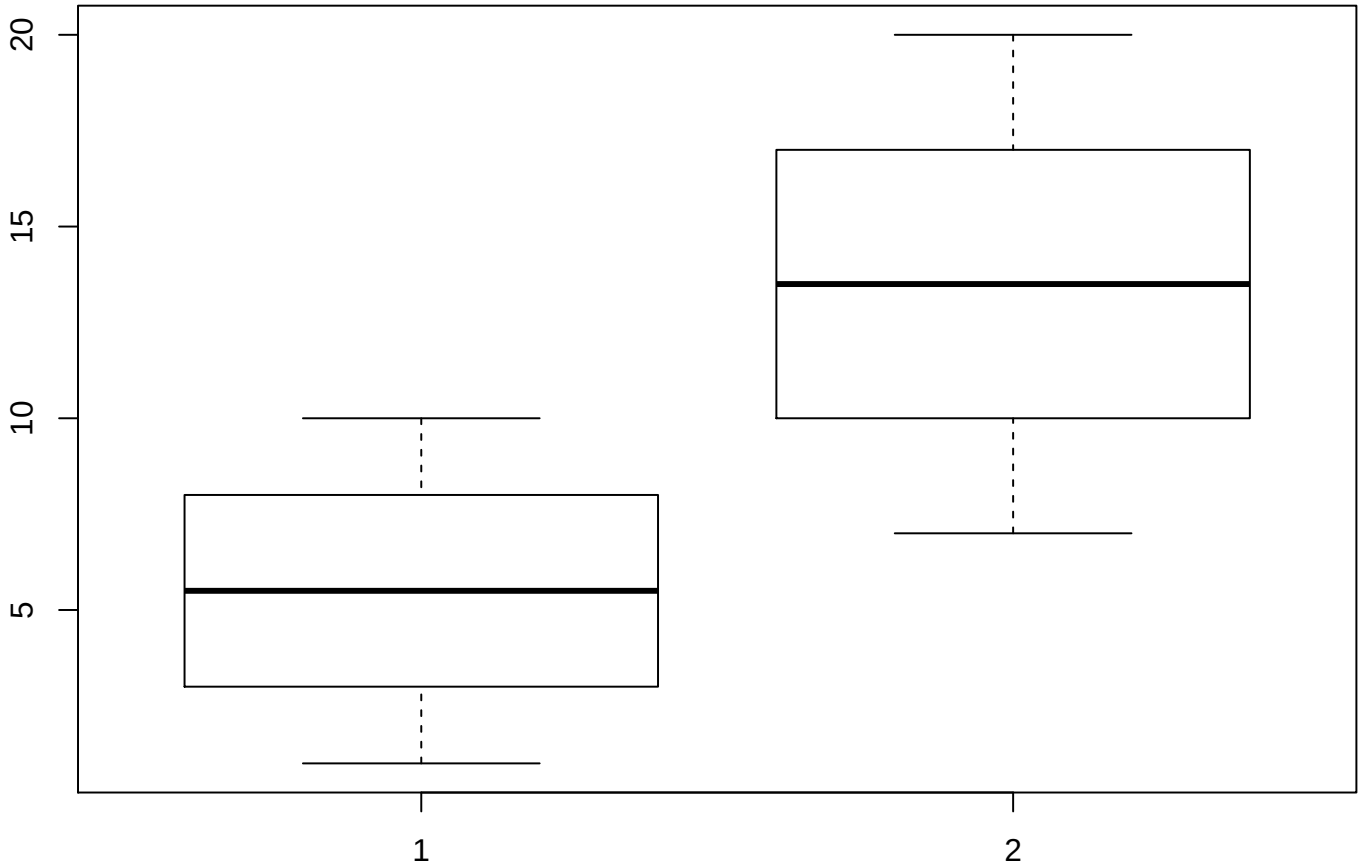
```
t.test(1:10, y = c(7:20))
```

```
Welch Two Sample t-test

data:  1:10 and c(7:20)
t = -5.4349, df = 21.982, p-value = 1.855e-05
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -11.052802  -4.947198
sample estimates:
mean of x mean of y
      5.5      13.5
```

T.test introduction

```
boxplot(c(1:10, 7:20) ~ c(rep(1,10), rep(2, 14)))
```



Are irises different?

Use t-tests to compare species in the iris dataset

The t.test problem

```
t.test(1:10, y = c(2:20,-9), var.equal = FALSE)


Welch Two Sample t-test

data:  1:10 and c(2:20, -9)
t = -2.4345, df = 27.642, p-value = 0.02163
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -8.2885317 -0.7114683
sample estimates:
mean of x mean of y
      5.5      10.0
```

The t.test problem

```
t.test(1:10, y = c(2:20,-9), var.equal = TRUE)


Two Sample t-test

data:  1:10 and c(2:20, -9)
t = -1.9134, df = 28, p-value = 0.06597
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -9.3175688  0.3175688
sample estimates:
mean of x mean of y
      5.5      10.0
```

The t.test problem

Random sample from a Gaussian distribution with variance 1

```
  set.seed(seed = 179)
  x1 <- rnorm(n = 20, mean = 0, sd = 1)
  x2 <- rnorm(n = 20, mean = 0, sd = 1)


  var(x1)

[1] 0.7040416

  var(x2)

[1] 1.810404
```

The t.test problem

```
  var.test(x = x1, y = x2)


F test to compare two variances

data:  x1 and x2
F = 0.38889, num df = 19, denom df = 19, p-value = 0.04593
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.1539260 0.9825028
sample estimates:
ratio of variances
         0.3888866
```

Should we use var.equal = TRUE or FALSE ?
When var.test significant/not?

Bonus open problems if you get bored

1. What is the fastest way to get row averages in a data-frame?
2. Create a function called colVars, like colMeans but for variance
3. Create nice plots to visualize iris data (ideally journal-quality)