生物科学基礎実験 II—生物統計学（補足プリント 2019 年 11 月 13 日）
例 1）フィッシャーのアヤメのデータを使った種間の形態の差

```
> library(lattice)
> source("http://aoki2.si.gunma-u.ac.jp/R/src/all.R", encoding="euc-jp")
> data(iris)
> iris
> str(iris)
> table(iris$Species)
> summary(iris, na.rm=TRUE)
> summary(subset(iris, Species=="setosa"), na.rm=TRUE)
> summary(subset(iris, Species=="versicolor"), na.rm=TRUE)
> summary(subset(iris, Species=="virginica"), na.rm=TRUE)
> by(iris[1:4], iris$Species, summary)
> plot(iris)
> plot(iris[1:4])
> pairs(iris[1:4], main = "Iris setosa/I. versicolor/I. virginica", pch = 21, bg
  = c("red", "green3", "blue")[unclass(iris$Species)])
> histogram(~ Sepal.Length, data=iris)
> histogram(~ Sepal.Length | Species, data=iris)
> histogram(~ Sepal.Width | Species, data=iris)
> histogram(~ Petal.Length | Species, data=iris)
> histogram(~ Petal.Width | Species, data=iris)
> iris_setosa <- subset(iris, iris$Species=="setosa")
> iris_setosa
> iris_versicolor <- subset(iris, iris$Species=="versicolor")
> iris_versicolor
> iris_virginica <- subset(iris, iris$Species=="virginica")
> iris_virginica
> tapply(iris$Sepal.Length, iris$Species, summary)
> hist(iris$Sepal.Length, right=FALSE, plot=FALSE)
> hist(iris$Sepal.Length, right=FALSE)
> hist(iris_setosa$Sepal.Length, right=FALSE)
> boxplot(iris$Sepal.Length)
> boxplot(iris_setosa$Sepal.Length, iris_versicolor$Sepal.Length,
    iris_virginica$Sepal.Length)
> cor.test(iris_setosa$Sepal.Lenght, iris_setosa$Sepal.Width)
> cor.test(iris_setosa$Sepal.Length, iris_setosa$Sepal.Width)
> plot(iris_setosa[1:4])
> var.test(iris_setosa$Sepal.Length, iris_versicolor$Sepal.Length)
> t.test(iris_setosa$Sepal.Length, iris_versicolor$Sepal.Length)
> result.pca <- pca(iris[1:4])
> summary(result.pca)
> pc1d <- result.pca$fs[,1]
> pc2d <- result.pca$fs[,2]
> pc3d <- result.pca$fs[,3]
> plot(pc1d, pc2d, pch=as.integer(iris$Species))
> plot(pc1d, pc3d, pch=as.integer(iris$Species))
> result.candis <- candis(iris[1:4], iris[5])
> result.candis
```

例2) 陽葉と陰葉の形態の差

No.	LeafLength (cm)	LeafWidth (cm)	LeafThick (mm)	Chloro (mg/10 cm^2)	WetWeight (g)	Sun/ShadeLeaf
1	8.88	3.78	0.43	66.9	0.858	Sun
2	9.05	4.32	0.41	65.1	1.014	Sun
3	8.50	3.75	0.41	66.1	0.783	Sun
4	8.20	3.00	0.39	72.0	0.691	Sun
5	7.90	3.30	0.33	56.2	0.586	Sun
6	8.92	3.68	0.43	67.0	0.913	Sun
7	8.80	3.49	0.41	71.2	0.834	Sun
8	9.02	3.22	0.45	70.4	0.880	Sun
9	8.75	3.60	0.43	72.9	0.935	Sun
10	8.45	3.42	0.40	65.7	0.788	Sun
11	8.10	3.35	0.33	59.6	0.671	Sun
12	8.82	3.20	0.37	64.8	0.739	Sun
13	8.58	3.50	0.35	56.4	0.677	Sun
14	9.00	3.45	0.42	63.7	0.850	Sun
15	8.95	3.42	0.41	56.0	0.794	Sun
16	8.62	4.02	0.36	66.8	0.753	Shade
17	7.75	3.25	0.32	60.5	0.506	Shade
18	7.70	3.38	0.37	63.4	0.567	Shade
19	8.93	3.92	0.34	64.2	0.747	Shade
20	8.70	2.90	0.33	61.6	0.513	Shade
21	8.73	3.44	0.35	64.5	0.655	Shade
22	7.35	3.18	0.31	56.4	0.472	Shade
23	7.52	3.20	0.34	47.6	0.504	Shade
24	7.90	3.74	0.34	68.8	0.662	Shade
25	9.24	3.82	0.37	61.1	0.748	Shade
26	7.78	3.15	0.31	60.2	0.479	Shade
27	8.00	3.22	0.36	59.7	0.584	Shade
28	7.65	3.20	0.33	61.9	0.599	Shade
29	8.33	3.78	0.34	58.1	0.647	Shade
30	7.42	2.62	0.27	57.4	0.414	Shade