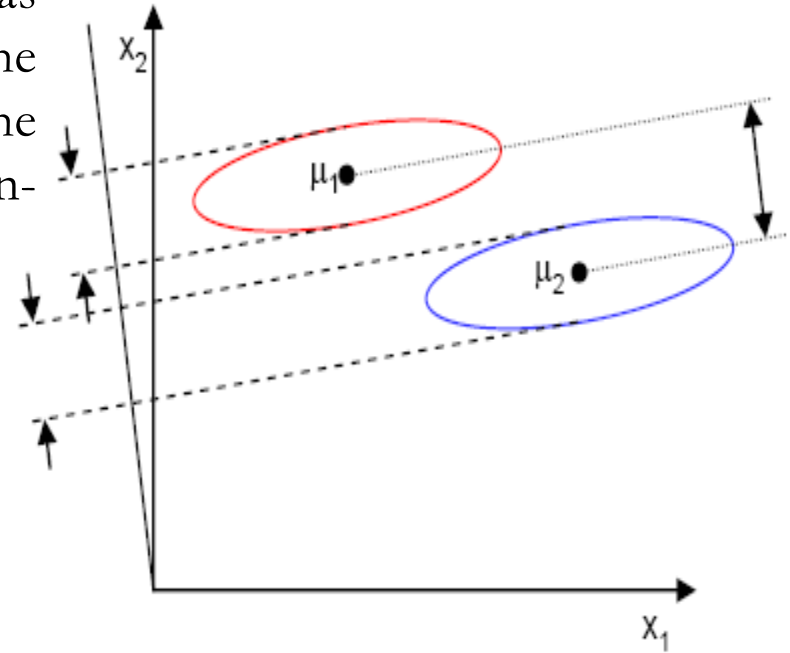


LDA ... Two Classes

- The Fisher linear discriminant is defined as the linear function $\mathbf{w}^T \mathbf{x}$ that maximizes the criterion function: (the distance between the projected means normalized by the within-class scatter of the projected samples).

$$J(\mathbf{w}) = \frac{|\tilde{\mu}_1 - \tilde{\mu}_2|^2}{\tilde{s}_1^2 + \tilde{s}_2^2}$$



- Therefore, we will be looking for a projection where examples from the same class are projected very close to each other and, at the same time, the projected means are as far apart as possible

LDA with Fisher's Iris Data

Three classes in the Iris dataset:

- Iris-setosa (n=50)
- Iris-versicolor (n=50)
- Iris-virginica (n=50)



Iris setosa



Iris versicolor



Iris virginica

Four features of the Iris dataset:

- sepal length in cm
- sepal width in cm
- petal length in cm
- petal width in cm

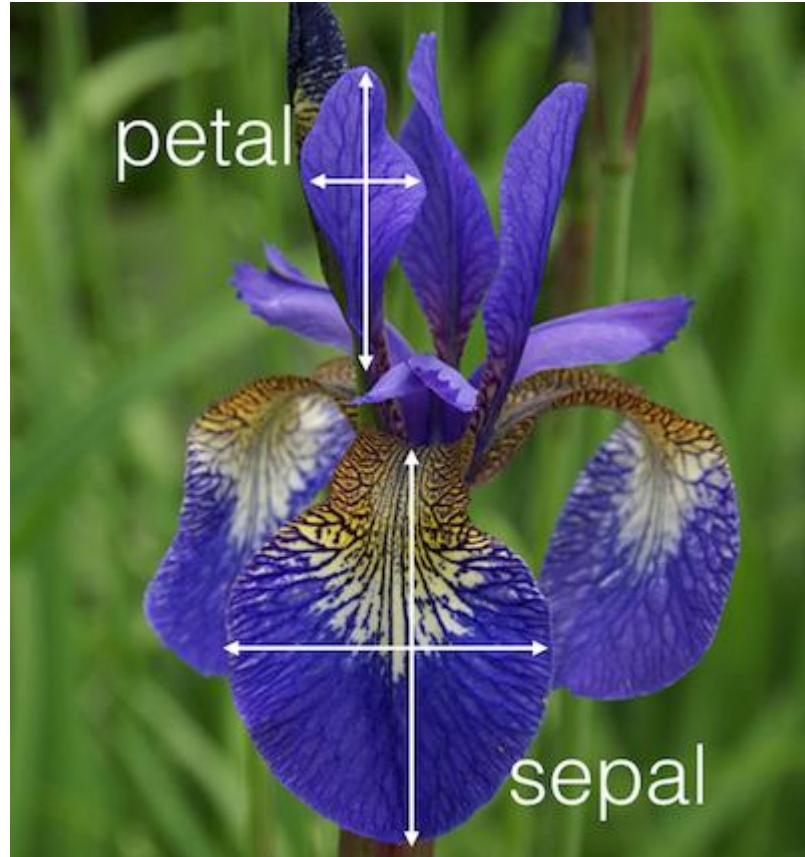
LDA with Fisher's Iris Data

Three classes in the Iris dataset:

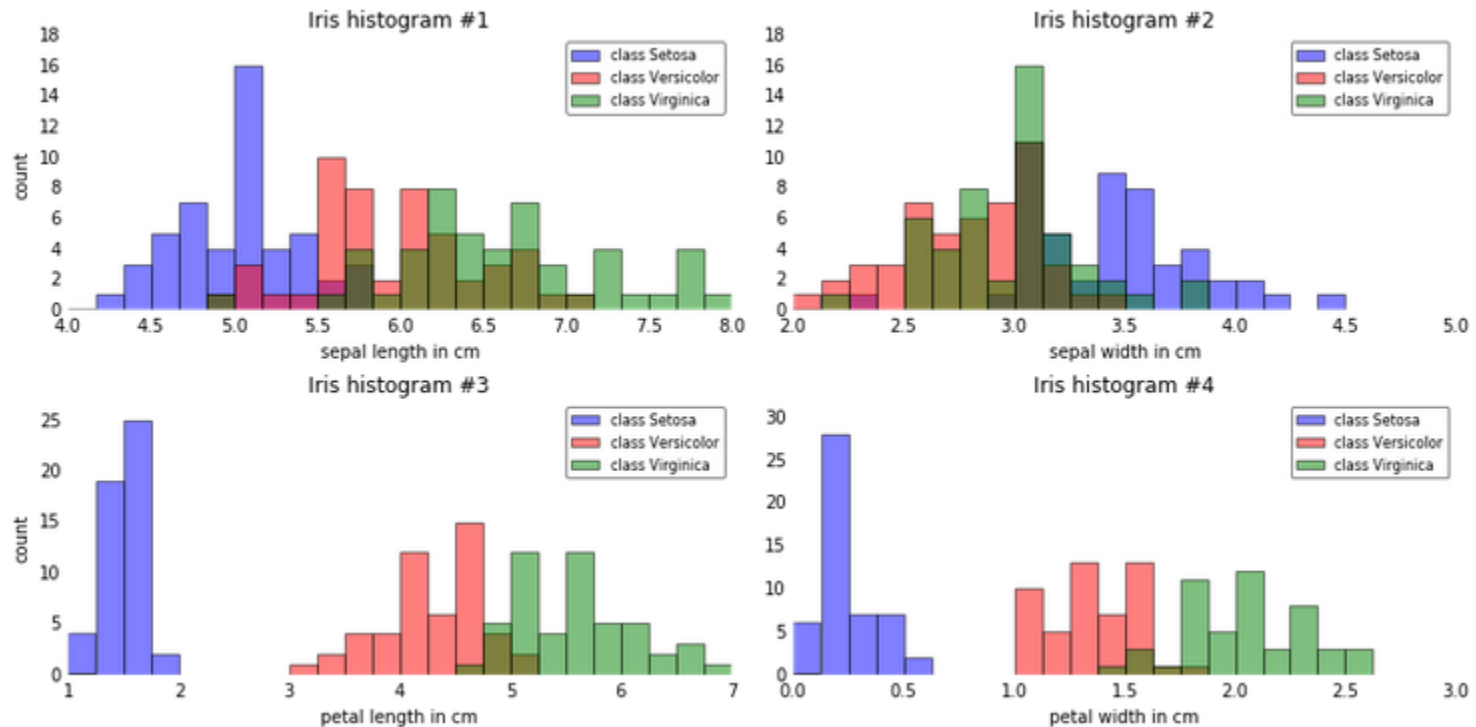
- Iris-setosa (n=50)
- Iris-versicolor (n=50)
- Iris-virginica (n=50)

Four features of the Iris dataset:

- sepal length in cm
- sepal width in cm
- petal length in cm
- petal width in cm



LDA with Fisher's Iris Data



```
require(MASS); data(iris); head(iris, 3)
```

```
lda.mod <- lda(Species ~ ., data = iris, prior = c(1,1,1)/3) # prior →  $\pi_k$ 
```

```
lda.pred <- predict(lda.mod, iris)
```

```
lda.pred.class <- lda.pred$class
```

```
table(lda.pred.class, iris$Species) # "confusion matrix"
```

```
lda.detail <- bind(as.character(lda.pred$class), round(lda.pred$posterior, 8))
```

```
lda.detail #134
```

```
plot(lda.pred$x[,1], lda.pred$x[,2], col=iris$Species) # OR plot(lda.mod)
```

LDA with Fisher's Iris Data

```
> lda.mod
```

```
Call: lda(Species ~ ., data = iris)
```

```
Prior probabilities of groups:
```

```
  setosa  versicolor  virginica  
0.3333333 0.3333333 0.3333333
```

```
Group means:
```

	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width
setosa	5.006	3.428	1.462	0.246
versicolor	5.936	2.770	4.260	1.326
virginica	6.588	2.974	5.552	2.026

```
Coefficients of linear discriminants:
```

	LD1	LD2
Sepal.Length	0.8293776	0.02410215
Sepal.Width	1.5344731	2.16452123
Petal.Length	-2.2012117	-0.93192121
Petal.Width	-2.8104603	2.83918785

```
Proportion of trace:
```

LD1	LD2
0.9912	0.0088