LDA but with TidyModels

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Load the Libraries

```
library(tidymodels) # for data preprocessing
library(discrim) # for the LDA
library(MASS) # for the LDA
library(ggplot2) # for plotting the distributions
library(gridExtra)
```

Set the seed:

```
set.seed(42)
```

Load the data

```
dir = 'data/DFA_df.txt'

data <- read.delim(dir, sep = ',') # load the data
```

Feature selection & factorisation of the response variable:

```
  df <- data %>%
  dplyr::select(-code) %>%
  mutate(y = as.factor(y))
```

I cannot standardise the data before partitioning: that's data leakage!

Visualisations

We need to check whether the data is normally distributed.

```
hist1 <- ggplot(df, aes(x1)) +
  geom_histogram() +
  geom_vline(aes(xintercept = mean(x1))) +
  geom_density()

hist2 <- ggplot(df, aes(x2)) +
  geom_histogram() +
  geom_vline(aes(xintercept = mean(x2))) +
  geom_density()

hist3 <- ggplot(df, aes(x3)) +
  geom_histogram() +
  geom_vline(aes(xintercept = mean(x3))) +
```

```
  geom_density()
```

Let's plot them altogether

```
grid.arrange(hist1, hist2, hist3)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
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```

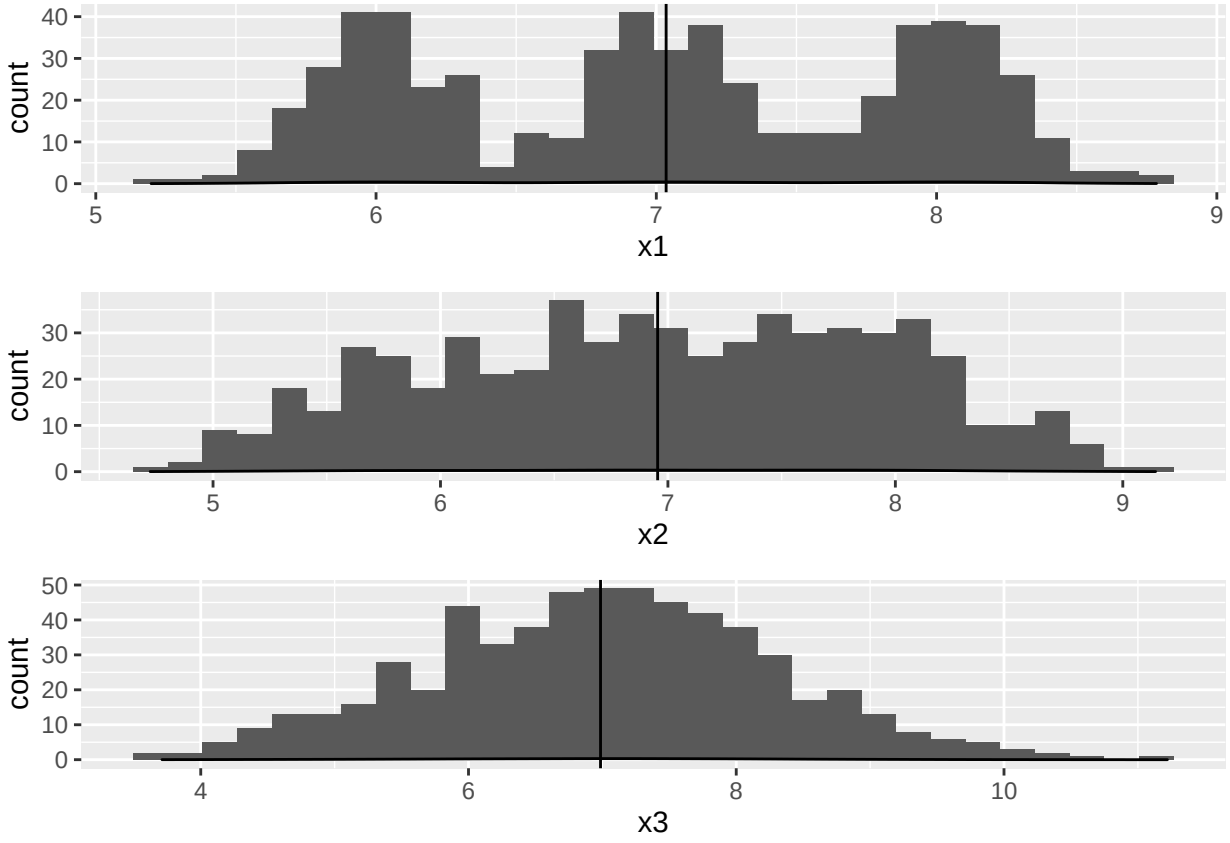

Partition the data

Create the split with `rsample`

```
df_split <- initial_split(df, strata = y)
```

View the training and test sets:

```
df_split %>%
  training() %>%
  glimpse()

df_split %>%
  testing() %>%
  glimpse()
```

Data pre-processing

Specify the recipe

```
df_recipe <- training(df_split) %>%
  recipe(y ~ .) %>% # write the formula
  step_center(all_predictors()) %>% # center all predictors
  step_scale(all_predictors()) %>%
  prep()
```

Obtain train and test data

By `juicing` and `baking` the recipe:

```
train_set <- juice(df_recipe)

test_set <- df_recipe %>%
  bake(testing(df_split))
```

We can also display train and test set:

```
train_set
test_set
```

Train and test set plotting

Much better, we can plot the train and the test set!

```
norm_1 <- train_set %>%
  ggplot() +
  geom_histogram(aes(x1), alpha = 1/2, fill = 'red')

norm_2 <- train_set %>%
  ggplot() +
  geom_histogram(aes(x2), alpha = 1/2, fill = 'blue')

norm_3 <- train_set %>%
  ggplot() +
  geom_histogram(aes(x3), alpha = 1/2, fill = 'green')
```

And display them in a single plot:

```
grid.arrange(norm_1, norm_2, norm_3)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
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```
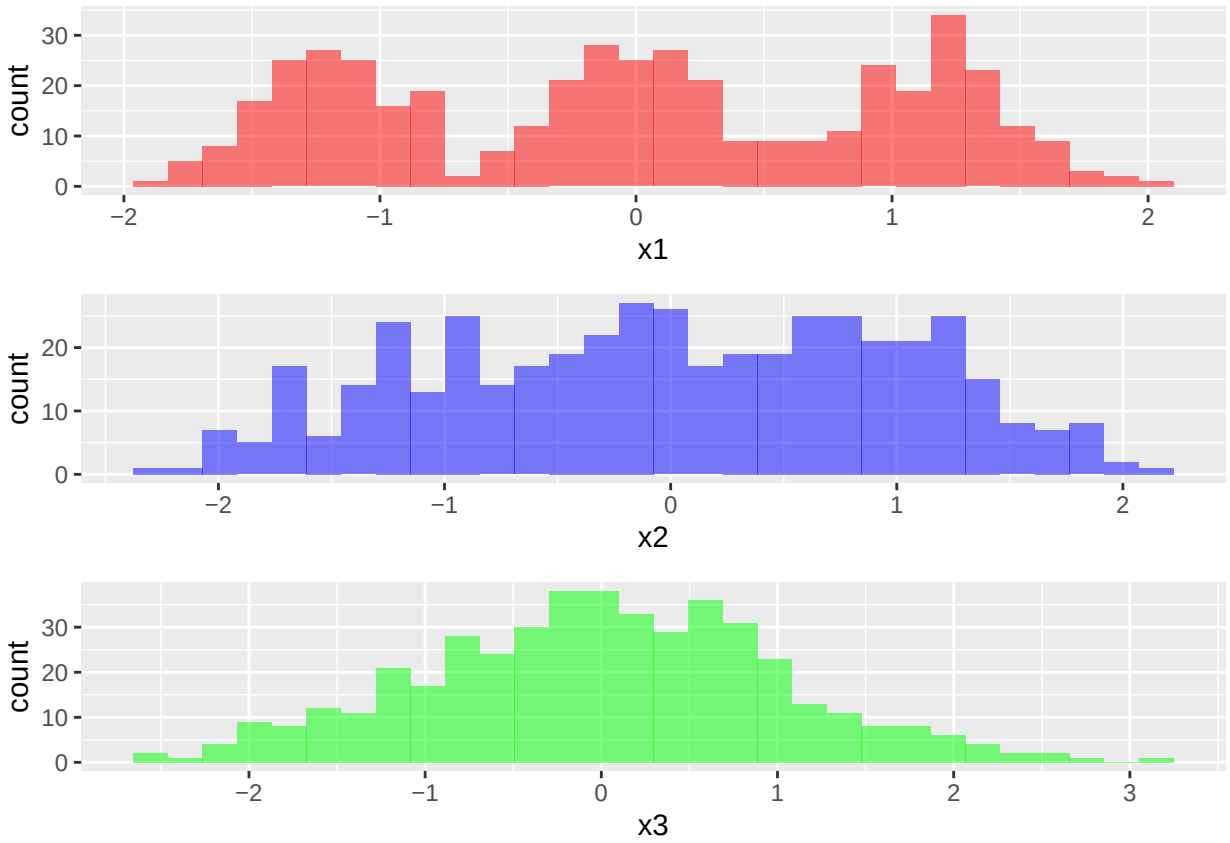



X does not seem normally distributed. One should proceed with further statistical tests, such as the KS.

LDA Model Fitting

Let's train the model:

```
lda_classifier <- discrim_linear(mode = 'classification') %>%
  set_engine('MASS') %>%
  fit(y ~ ., data = train_set)
```

Prediction

Then let's predict!

```
lda_classifier %>%
  predict(test_set) %>%
  bind_cols(test_set) %>%
  glimpse()
```

```
## Rows: 149
## Columns: 5
## $ .pred_class <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1...
## $ x1          <dbl> -1.1150519, -1.2677394, -1.0706468, -1.1984440, -1.4192...
## $ x2          <dbl> -1.4955796, -1.5375500, -1.0580184, -1.6181565, -1.4135...
## $ x3          <dbl> 0.45062147, -1.78310337, 0.50185812, -1.74745968, -0.48...
## $ y           <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1...
```

`Tidymodels` will create the colums `.pred_class`: that is our prediction.

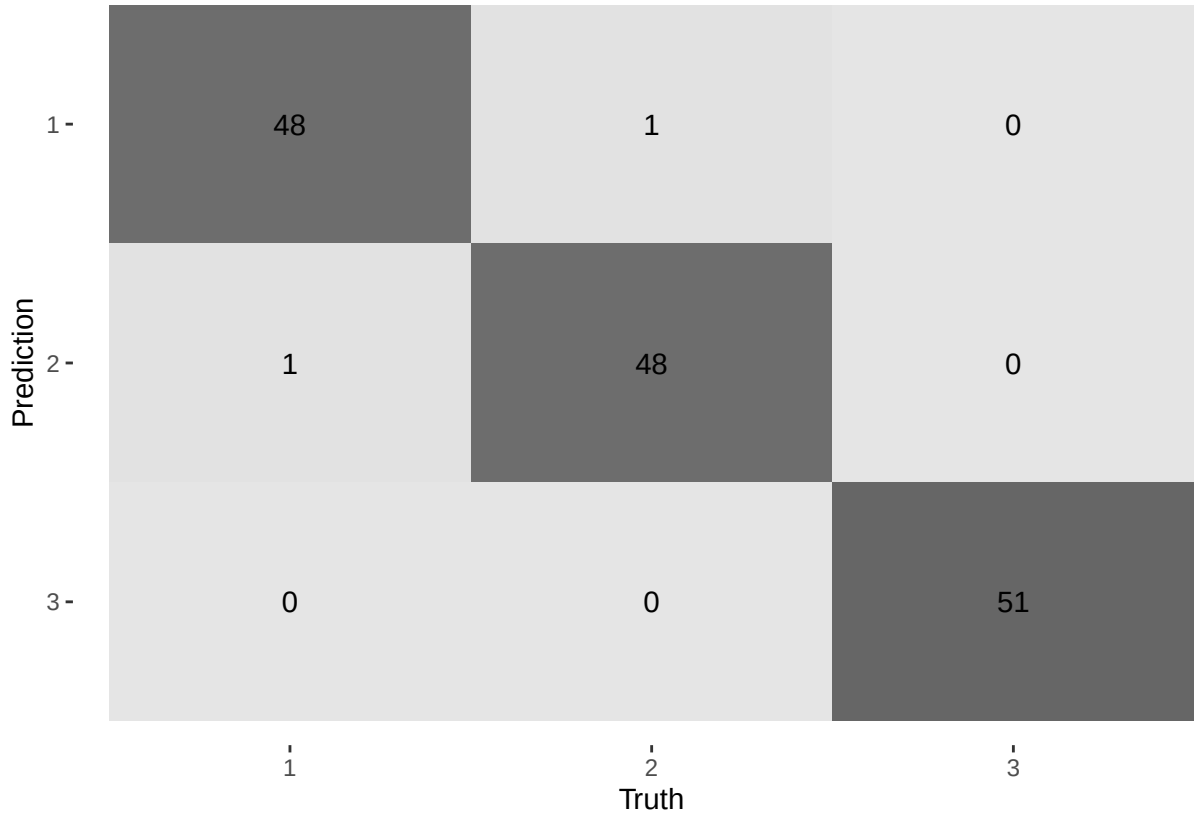
Model Validation

```
lda_classifier %>%
  predict(test_set) %>%
  bind_cols(test_set) %>%
  metrics(truth = y, estimate = .pred_class)
```

```
## # A tibble: 2 x 3
##   .metric  .estimator .estimate
##   <chr>    <chr>          <dbl>
## 1 accuracy multiclass     0.987
## 2 kap      multiclass     0.980
```

Confusion Matrix

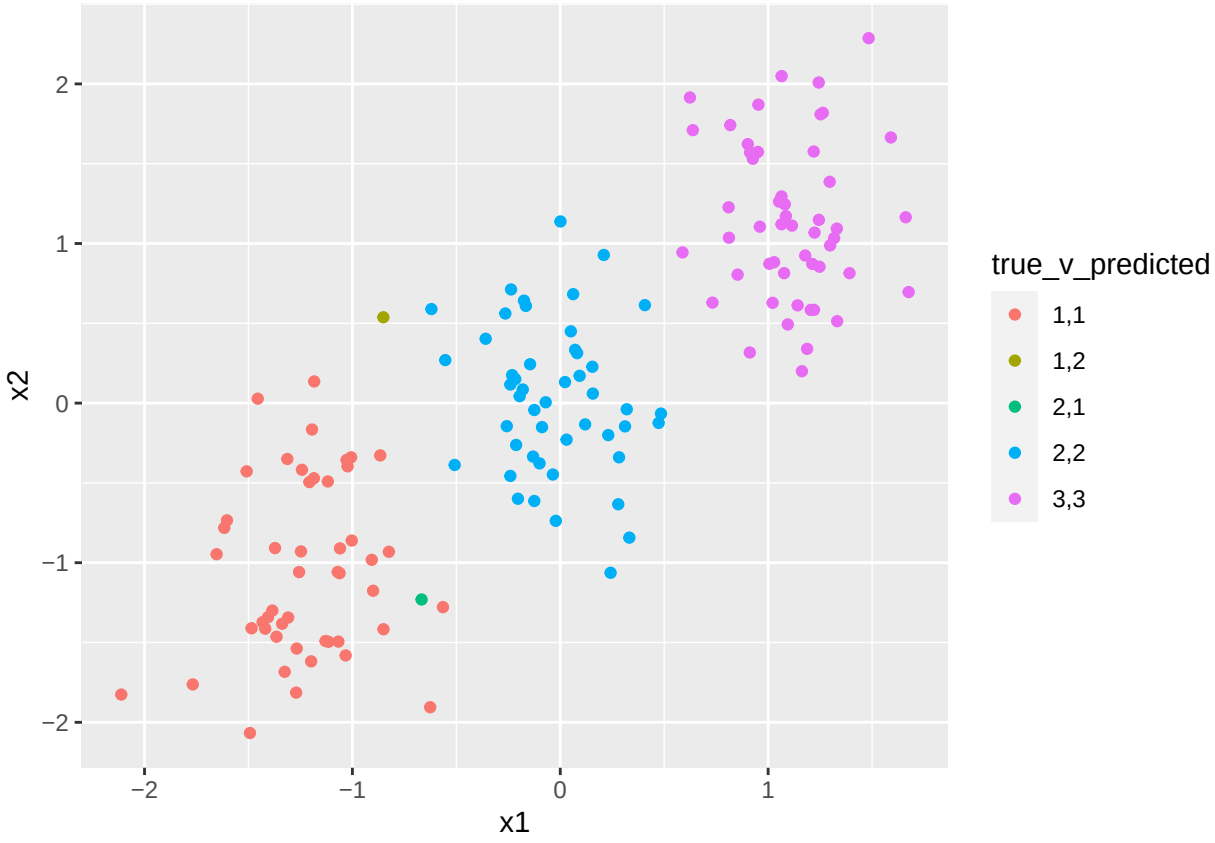
```
lda_classifier %>%
  predict(test_set) %>%
  bind_cols(test_set) %>%
  conf_mat(y, .pred_class) %>%
  autoplot(type = 'heatmap')
```



Let's visualise it once more

Then, let's add a layer of complications to visualise how we plotted it, but only in 2D.

```
test_set <- lda_classifier %>%
  predict(test_set) %>%
  bind_cols(test_set)

test_set %>%
  mutate(true_v_predicted = paste(test_set$y, test_set$.pred_class, sep = ',')) %>%
  ggplot() +
  geom_point(aes(x1, x2, col = true_v_predicted))
```



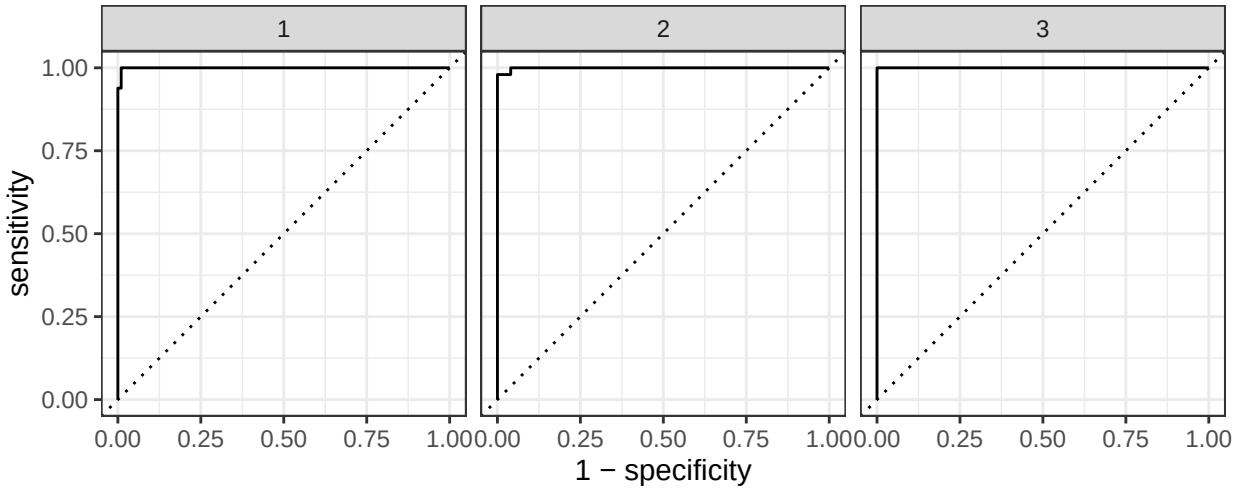
Per-classifier metrics

We can obtain the metrics for each class by simply specifying a different argument in `predict`:

```
lda_probs <- lda_classifier %>%
  predict(test_set, type = 'prob') %>%
  bind_cols(test_set)
```

And we can immediately plot some curves:

```
lda_probs %>%
  roc_curve(y, .pred_1:.pred_3) %>%
  autoplot()
```


1
2
3
sensitivity
1.00
0.75
0.50
0.25
0.00
0.00
0.25
0.50
0.75
1.00
1 − specificity