raisin

April 4, 2023

[46]:
```
library(tidyverse)
library(tidymodels)
library(repr)
library(readxl)
library(GGally)
library(digest)
library(cowplot)
library(gridExtra)

set.seed(123)
```

```
Attaching package: ‘gridExtra’


The following object is masked from ‘package:dplyr’:

    combine
```

[9]:
```
getwd()
```

’/home/jovyan/DSCI100-project’

[10]:
```
raisin <- read_csv("/home/jovyan/DSCI100-project/raisin.csv")|>
    mutate(Class = as_factor(Class))
glimpse(raisin)
```

```
Rows: 900 Columns: 8
  Column specification

Delimiter: ","
chr (1): Class
dbl (7): Area, MajorAxisLength, MinorAxisLength, Eccentricity,
ConvexArea, E…

 Use `spec()` to retrieve the full column specification for this
```

```
data.
  Specify the column types or set `show_col_types = FALSE` to quiet
this message.

Rows: 900
Columns: 8
$ Area            <dbl> 87524, 75166, 90856, 45928, 79408,
49242, 42492, 60952…
$ MajorAxisLength <dbl> 442.2460, 406.6907, 442.2670,
286.5406, 352.1908, 318.…
$ MinorAxisLength <dbl> 253.2912, 243.0324, 266.3283,
208.7600, 290.8275, 200.…
$ Eccentricity    <dbl> 0.8197384, 0.8018052, 0.7983536,
0.6849892, 0.5640113,…
$ ConvexArea      <dbl> 90546, 78789, 93717, 47336, 81463,
51368, 43904, 62329…
$ Extent          <dbl> 0.7586506, 0.6841296, 0.6376128,
0.6995994, 0.7927719,…
$ Perimeter       <dbl> 1184.040, 1121.786, 1208.575,
844.162, 1073.251, 881.8…
$ Class           <fct> Kecimen, Kecimen, Kecimen, Kecimen,
Kecimen, Kecimen, …
```

[11]:
```
raisin_split <- initial_split(raisin, prop = .75, strata = Class)
raisin_train <- training(raisin_split)
raisin_test <- testing(raisin_split)
```

[12]:
```
raisin_summarize <- raisin_train |>
    group_by(Class) |>
    summarize(Area_mean = mean(Area), MajorAxisLength_mean =␣
 ↪mean(MajorAxisLength), MinorAxisLength_mean = mean(MinorAxisLength),
              Eccentricity_mean = mean(Eccentricity), ConvexArea_mean =␣
 ↪mean(ConvexArea), Extent_mean = mean(Extent),
                  Perimeter_mean = mean(Perimeter), observations = n())
raisin_summarize
```

A tibble: 2 × 9

Class <fct>	Area_mean <dbl>	MajorAxisLength_mean <dbl>	MinorAxisLength_mean <dbl>	Eccentricity_mea <dbl>
Kecimen	63994.55	355.2678	230.0726	0.7435603
Besni	110053.10	503.0439	277.7713	0.8196521

[13]:
```
#Use ggpairs function to look at relationship between different variables.
ggpairs(raisin_train)
```

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

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```

```
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```
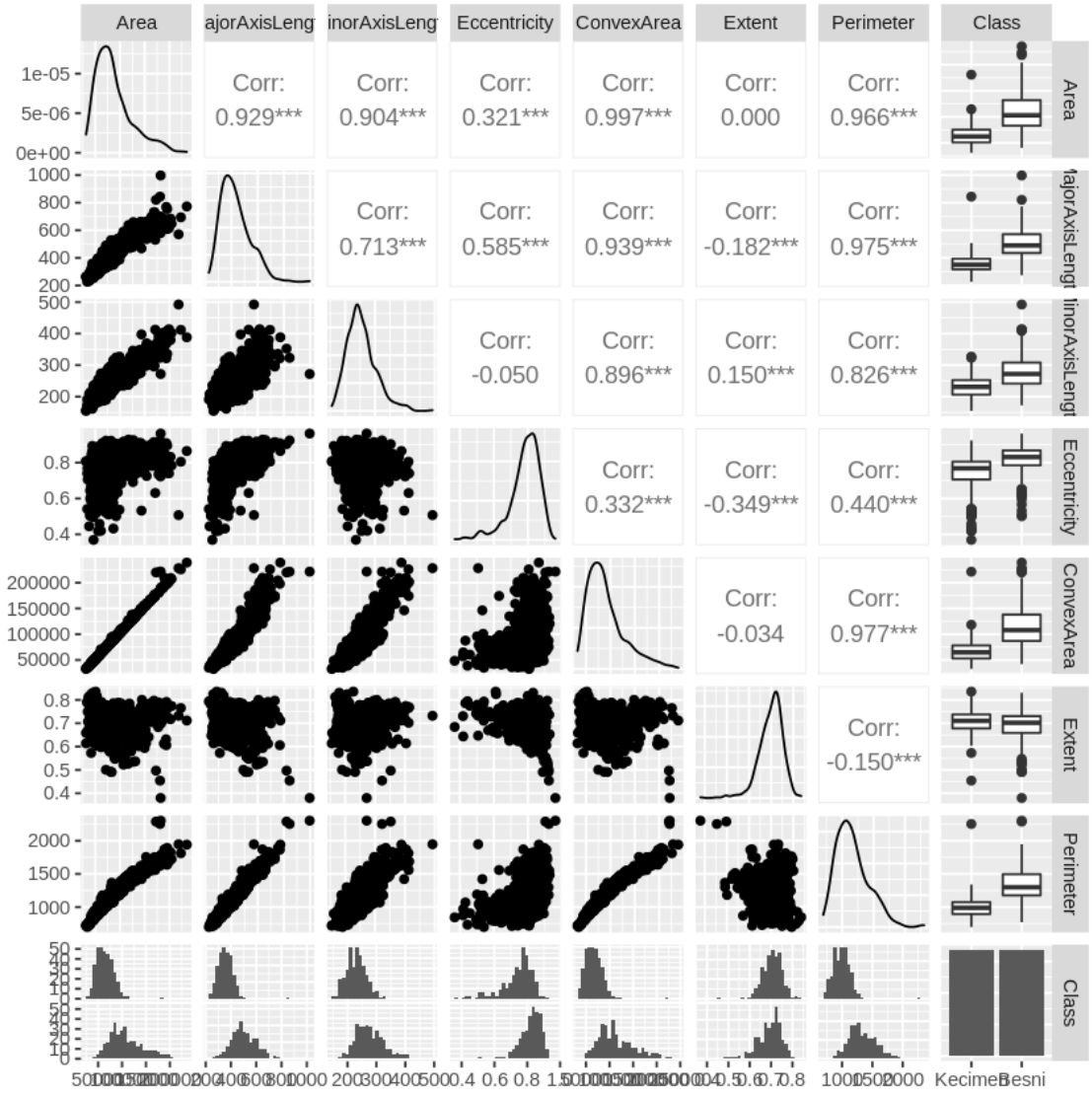



[14]:
```
##Based on the above plots, 4 variables were selected as having a high␣
↪correlation with the type of raisin:
```

```
#Area, Majour Axis Length, Convex area and perimeter.

#Those variables were then plotted against each other.
```

[15]:
```
plot_1 <- raisin_train |>
    ggplot(aes(x = Area, y = MajorAxisLength, color = Class)) +
    geom_point() +
    labs(x = "Area", y = "Major Axis Length", color = "Class")
```

[16]:
```
plot_2 <- raisin_train |>
    ggplot(aes(x = Area, y = Perimeter, color = Class)) +
    geom_point() +
    labs(x = "Area", y = "Perimeter", color = "Class")
```

[17]:
```
plot_3 <- raisin_train |>
    ggplot(aes(x = Area, y = ConvexArea, color = Class)) +
    geom_point() +
    labs(x = "Perimeter", y = "Convex Area", color = "Class")
```

[18]:
```
plot_4 <- raisin_train |>
    ggplot(aes(x = MajorAxisLength, y = ConvexArea, color = Class)) +
    geom_point() +
    labs(x = "Major Axis Length", y = "Convex Area", color = "Class")
```

[19]:
```
plot_5 <- raisin_train |>
    ggplot(aes(x = MajorAxisLength, y = Perimeter, color = Class)) +
    geom_point() +
    labs(x = "Area", y = "Perimeter", color = "Class")
```

[20]:
```
plot_6 <- raisin_train |>
    ggplot(aes(x = ConvexArea, y = Perimeter, color = Class)) +
    geom_point() +
    labs(x = "Convex Area", y = "Perimeter", color = "Class")
```

[21]:
```
#Create Classification model
```

[22]:
```
raisin_proportions <- raisin_train |>
                      group_by(Class) |>
                      summarize(n = n()) |>
                      mutate(percent = 100*n/nrow(raisin_train))
raisin_proportions
```

A tibble: 2 × 3

Class <fct>	n <int>	percent <dbl>
Kecimen	337	50
Besni	337	50

[23]:
```
whole_raisin_proportions <- raisin |>
                        group_by(Class) |>
                        summarize(n = n()) |>
                        mutate(percent = 100*n/nrow(raisin))
whole_raisin_proportions
```

A tibble: 2 × 3

Class	n	percent
<fct>	<int>	<dbl>
Kecimen	450	50
Besni	450	50

[24]:
```
#We can see here that the proportion of the each class has been presevered␣
↪during the splitting of the groups.
```

[25]:
```
raisin_recipe <- recipe(Class ~ Area + MajorAxisLength + Perimeter +␣
↪ConvexArea, data = raisin_train) |>
  step_scale(all_predictors()) |>
  step_center(all_predictors())
raisin_recipe
```

```
Recipe

Inputs:

      role #variables
   outcome          1
 predictor          4

Operations:

Scaling for all_predictors()
Centering for all_predictors()
```

[26]:
```
#tuning Classifier
```

[27]:
```
raisin_vfold <- vfold_cv(raisin_train, v = 5, strata = Class)

knn_spec <- nearest_neighbor(weight_func = "rectangular", neighbors = 3) |>
  set_engine("kknn") |>
  set_mode("classification")

knn_fit <- workflow() |>
  add_recipe(raisin_recipe) |>
  add_model(knn_spec) |>
  fit_resamples(resamples = raisin_vfold)|>
  collect_metrics()
```

```
knn_fit
```

A tibble: 2 × 6

.metric	.estimator	mean	n	std_err	.config
<chr>	<chr>	<dbl>	<int>	<dbl>	<chr>
accuracy	binary	0.8265145	5	0.009895505	Preprocessor1_Model1
roc_auc	binary	0.8822233	5	0.008819497	Preprocessor1_Model1

[28]:
```
raisin_vfold_metrics <- workflow() |>
                  add_recipe(raisin_recipe) |>
                  add_model(knn_spec) |>
                  fit_resamples(resamples = raisin_vfold) |>
                  collect_metrics()
raisin_vfold_metrics
```

A tibble: 2 × 6

.metric	.estimator	mean	n	std_err	.config
<chr>	<chr>	<dbl>	<int>	<dbl>	<chr>
accuracy	binary	0.8265145	5	0.009895505	Preprocessor1_Model1
roc_auc	binary	0.8822233	5	0.008819497	Preprocessor1_Model1

[29]:
```
knn_spec <- nearest_neighbor(weight_func = "rectangular",
                             neighbors = tune()) |>
  set_engine("kknn") |>
  set_mode("classification")
```

[30]:
```
knn_fit <- workflow() |>
  add_recipe(raisin_recipe) |>
  add_model(knn_spec) |>
  fit(data = raisin_train)
knn_fit
```

```
Warning message:
"tune samples were requested but there were 674 rows in the data. 669 will be
used."
```

```
  Workflow [trained]
Preprocessor: Recipe
Model: nearest_neighbor()

  Preprocessor
2 Recipe Steps

• step_scale()
• step_center()

  Model

Call:
kknn::train.kknn(formula = ..y ~ ., data = data, ks = min_rows(tune(),     data,␣
  ↪5), kernel = ~"rectangular")
```

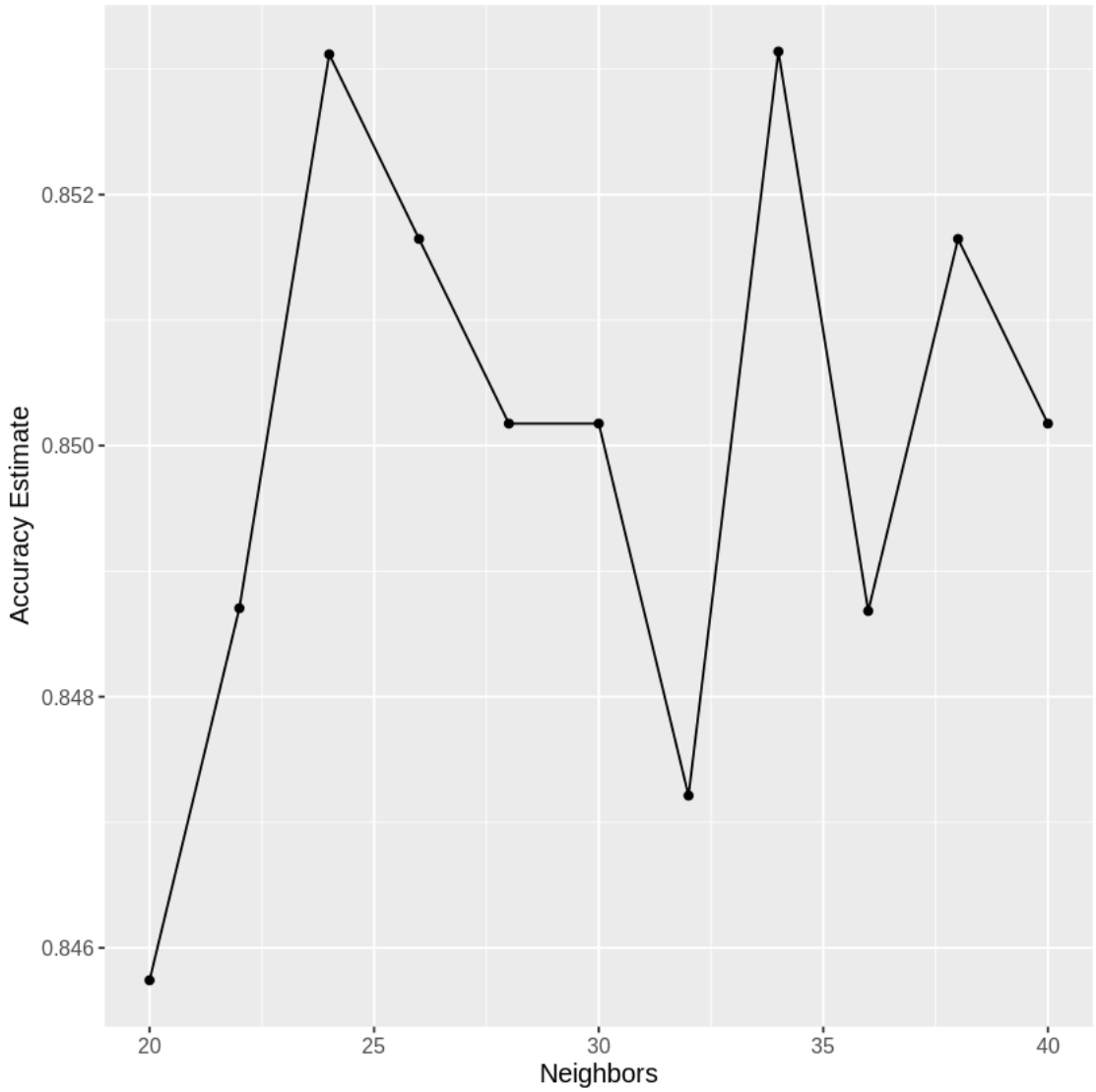
```
Type of response variable: nominal
Minimal misclassification: 0.3382789
Best kernel: rectangular
Best k: 669
```

[31]:
```
k_vals <- tibble(neighbors = seq(from = 20, to = 40, by = 2))

knn_results <- workflow() |>
  add_recipe(raisin_recipe) |>
  add_model(knn_spec) |>
  tune_grid(resamples = raisin_vfold, grid = k_vals) |>
  collect_metrics()

accuracies <- knn_results |>
  filter(.metric == "accuracy")

accuracies
```

A tibble: 11 × 7

neighbors <dbl>	.metric <chr>	.estimator <chr>	mean <dbl>	n <int>	std_err <dbl>	.config <chr>
20	accuracy	binary	0.8457419	5	0.007333637	Preprocessor1_Model01
22	accuracy	binary	0.8487050	5	0.005759866	Preprocessor1_Model02
24	accuracy	binary	0.8531168	5	0.005884400	Preprocessor1_Model03
26	accuracy	binary	0.8516462	5	0.006955676	Preprocessor1_Model04
28	accuracy	binary	0.8501756	5	0.008152421	Preprocessor1_Model05
30	accuracy	binary	0.8501756	5	0.009092947	Preprocessor1_Model06
32	accuracy	binary	0.8472125	5	0.006254948	Preprocessor1_Model07
34	accuracy	binary	0.8531387	5	0.007020480	Preprocessor1_Model08
36	accuracy	binary	0.8486831	5	0.006745316	Preprocessor1_Model09
38	accuracy	binary	0.8516462	5	0.007672639	Preprocessor1_Model10
40	accuracy	binary	0.8501756	5	0.007019022	Preprocessor1_Model11

[32]:
```
accuracy_vs_k <- ggplot(accuracies, aes(x = neighbors, y = mean)) +
  geom_point() +
  geom_line() +
  labs(x = "Neighbors", y = "Accuracy Estimate") +
  theme(text = element_text(size = 12))

accuracy_vs_k
```



[33]:
```
knn_spec <- nearest_neighbor(weight_func = "rectangular", neighbors = 25) |>
  set_engine("kknn") |>
  set_mode("classification")

knn_fit <- workflow() |>
  add_recipe(raisin_recipe) |>
  add_model(knn_spec) |>
  fit(data = raisin_train)

knn_fit
```

```
  Workflow [trained]
Preprocessor: Recipe
```

```
Model: nearest_neighbor()

  Preprocessor
2 Recipe Steps

• step_scale()
• step_center()

  Model

Call:
kknn::train.kknn(formula = ..y ~ ., data = data, ks = min_rows(25,     data, 5),␣
 ↪kernel = ~"rectangular")

Type of response variable: nominal
Minimal misclassification: 0.152819
Best kernel: rectangular
Best k: 25
```

[34]:
```
raisin_predictions <- predict(knn_fit, raisin_test) |>
  bind_cols(raisin_test)

glimpse(raisin_predictions)
```

```
Rows: 226
Columns: 9
$ .pred_class     <fct> Besni, Besni, Kecimen, Kecimen,
Kecimen, Kecimen, Keci…
$ Area            <dbl> 87524, 90856, 79408, 43441, 33565,
57346, 75620, 73167…
$ MajorAxisLength <dbl> 442.2460, 442.2670, 352.1908,
276.6108, 261.5543, 330.…
$ MinorAxisLength <dbl> 253.2912, 266.3283, 290.8275,
201.8131, 167.7085, 222.…
$ Eccentricity    <dbl> 0.8197384, 0.7983536, 0.5640113,
0.6838823, 0.7673743,…
$ ConvexArea      <dbl> 90546, 93717, 81463, 45133, 35794,
59365, 77493, 74545…
$ Extent          <dbl> 0.7586506, 0.6376128, 0.7927719,
0.6908556, 0.6815505,…
$ Perimeter       <dbl> 1184.040, 1208.575, 1073.251,
803.748, 751.413, 928.27…
$ Class           <fct> Kecimen, Kecimen, Kecimen, Kecimen,
Kecimen, Kecimen, …
```

[35]:
```
raisin_predictions |>
  metrics(truth = Class, estimate = .pred_class) |>
```

```
  filter(.metric == "accuracy")
```

A tibble: 1 × 3

.metric	.estimator	.estimate
<chr>	<chr>	<dbl>
accuracy	binary	0.880531

[36]:
```
confusion_mat <- raisin_predictions |>
             conf_mat(truth = Class, estimate = .pred_class)
confusion_mat
```

```
          Truth
Prediction Kecimen Besni
   Kecimen     103    17
   Besni        10    96
```

[37]:
```
glimpse(raisin_train)
```

```
Rows: 674
Columns: 8
$ Area            <dbl> 117592, 96582, 61409, 134303, 83107,
107178, 64391, 12…
$ MajorAxisLength <dbl> 533.2929, 446.7052, 403.7013,
600.7663, 507.3809, 508.…
$ MinorAxisLength <dbl> 288.5583, 278.3255, 209.3659,
288.3849, 233.1538, 270.…
$ Eccentricity    <dbl> 0.8409660, 0.7821716, 0.8550074,
0.8772529, 0.8881652,…
$ ConvexArea      <dbl> 123587, 100113, 67286, 138133, 93706,
110611, 68813, 1…
$ Extent          <dbl> 0.7300677, 0.7065976, 0.5973929,
0.7424362, 0.4910020,…
$ Perimeter       <dbl> 1432.006, 1216.979, 1083.477,
1497.515, 1367.331, 1325…
$ Class           <fct> Besni, Besni, Besni, Besni, Besni,
Besni, Besni, Besni…
```

[ ]:
```

```

[38]:
```
#Visualizations of the analysis
```

[57]:
```
plot2.1 <- raisin_test |>
    ggplot(aes(x = Area, y= MajorAxisLength, color = Class))+
    geom_point(alpha = 0.6)+
    labs(x = "Area" , y = "Major Axis Length", color = "Class",
        subtitle="Area vs. Major Axis Length")+
  theme(text = element_text(size = 12))

plot2.2 <- raisin_predictions |>
```

```
    ggplot(aes(x = Area, y= MajorAxisLength, color = .pred_class))+
    geom_point(alpha = 0.6)+
    labs(x = "Area" , y = "Major Axis Length", color = "Predicted Class",
        subtitle="Area vs. Major Axis Length")+
  theme(text = element_text(size = 12))
```

[58]:
```
plot2.3 <- raisin_test |>
    ggplot(aes(x = Area, y= ConvexArea, color = Class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 7")+
    labs(x = "Area" , y = "Major Axis Length", color = "Class",
        subtitle="Area vs. Convex Area")+
  theme(text = element_text(size = 12))

plot2.4 <- raisin_predictions |>
    ggplot(aes(x = Area, y= ConvexArea, color = .pred_class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 7")+
    labs(x = "Area" , y = "Major Axis Length", color = "Predicted Class",
        subtitle="Area vs. Convex Area")+
  theme(text = element_text(size = 12))
```

[59]:
```
plot2.5 <- raisin_test |>
    ggplot(aes(x = Area, y= Perimeter, color = Class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 8")+
    labs(x = "Area" , y = "Perimeter", color = "Class",
        subtitle="Area vs. Perimeter")+
  theme(text = element_text(size = 12))

plot2.6 <- raisin_predictions |>
    ggplot(aes(x = Area, y= Perimeter, color = .pred_class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 8")+
    labs(x = "Area" , y = "Perimeter", color = "Predicted Class",
        subtitle="Area vs. Perimeter")+
    theme(text = element_text(size = 12))
```

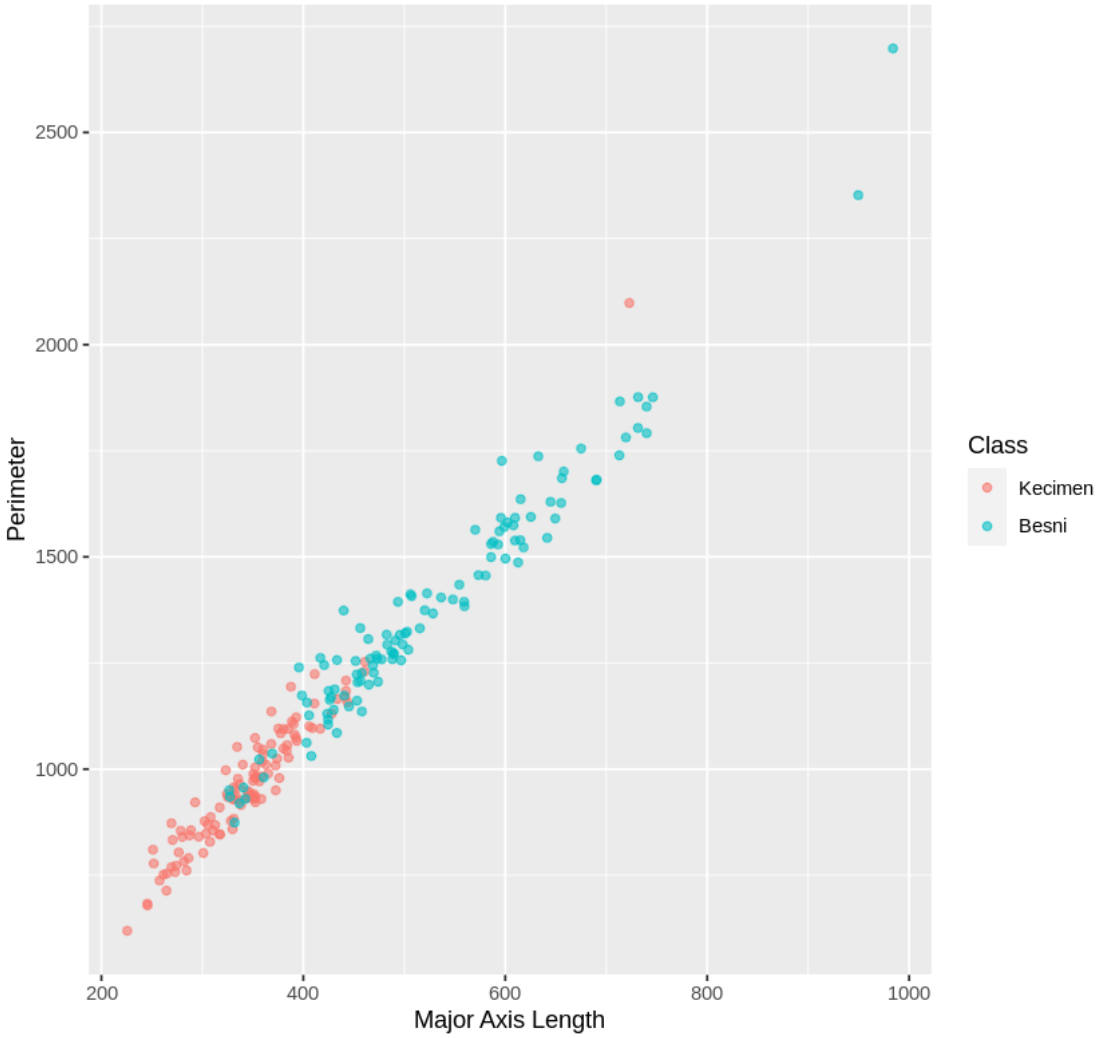
[60]:
```
plot2.7 <- raisin_test |>
    ggplot(aes(x = MajorAxisLength, y= ConvexArea, color = Class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 9")+
    labs(x = "Major Axis Length" , y = "Convex Area", color = "Class",
        subtitle = "Major Axis Length vs. Convex Area")+
      theme(text = element_text(size = 12))

plot2.8 <- raisin_predictions |>
```

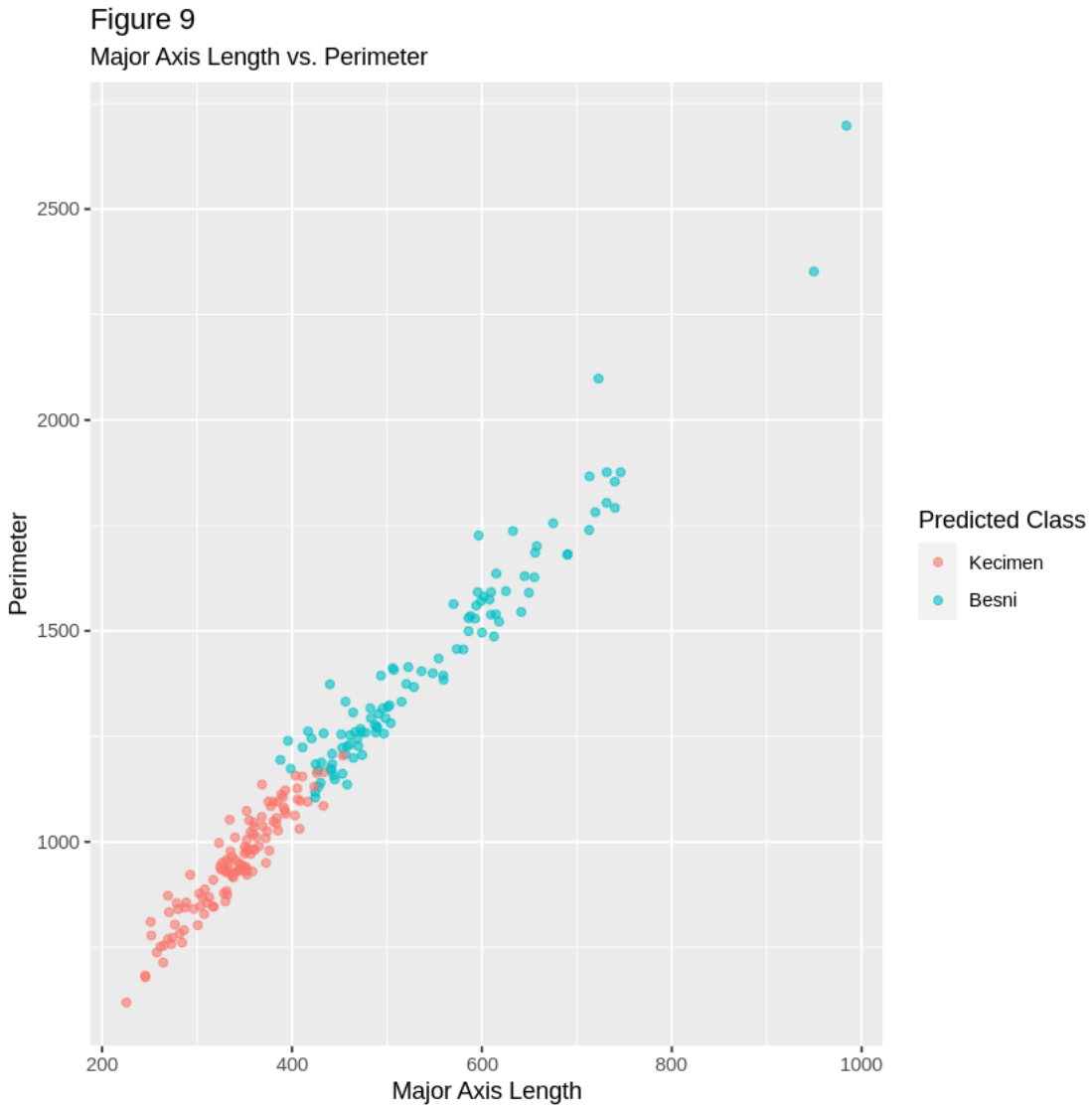
```
    ggplot(aes(x = MajorAxisLength, y= ConvexArea, color = .pred_class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 9")+
    labs(x = "Major Axis Length" , y = "Convex area", color = "Predicted Class",
        subtitle = "Major Axis Length vs. Convex Area")+
      theme(text = element_text(size = 12))
```

[43]:
```
plot2.9 <- raisin_test |>
    ggplot(aes(x = MajorAxisLength, y= Perimeter, color = Class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 9")+
    labs(x = "Major Axis Length" , y = "Perimeter", color = "Class",
        subtitle = "Major Axis Length vs. Perimeter")

plot2.10 <- raisin_predictions |>
    ggplot(aes(x = MajorAxisLength, y= Perimeter, color = .pred_class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 9")+
    labs(x = "Major Axis Length" , y = "Perimeter", color = "Predicted Class",
        subtitle = "Major Axis Length vs. Perimeter")
plot2.9
plot2.10
```

Figure 9

Major Axis Length vs. Perimeter





[44]:
```
plot2.11 <- raisin_test |>
    ggplot(aes(x = ConvexArea, y= Perimeter, color = Class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 10")+
    labs(x = "Convex Area" , y = "Perimeter", color = "Class",
        subtitle = "Convex Area vs. Perimeter")

plot2.12 <- raisin_predictions |>
    ggplot(aes(x = ConvexArea, y= Perimeter, color = .pred_class))+
    geom_point(alpha = 0.6)+
    ggtitle("Figure 10")+
    labs(x = "Convex Area" , y = "Perimeter", color = "Predicted Class",
        subtitle = "Convex Area vs. Perimeter")
```

Figure 10

Convex Area vs. Perimeter

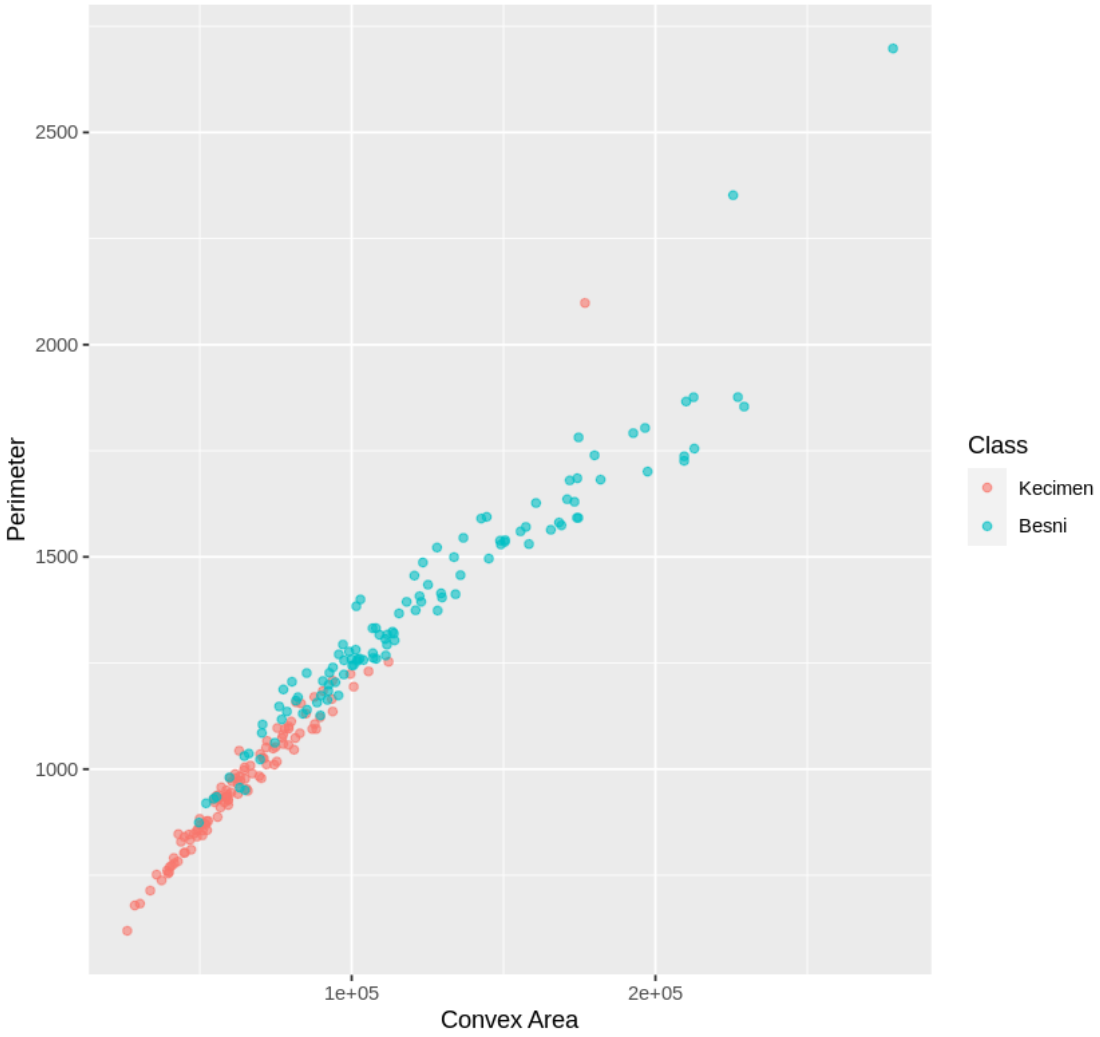
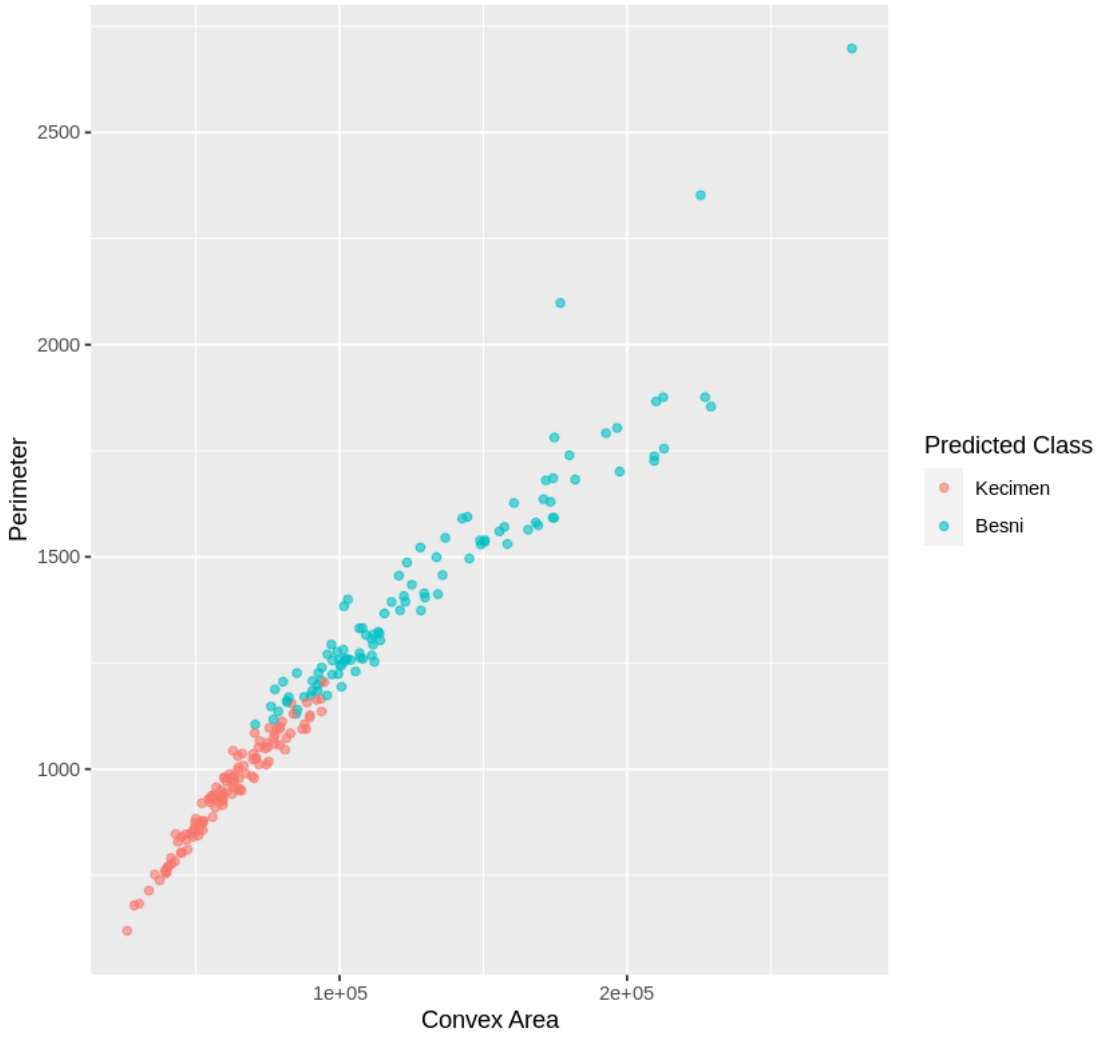


Figure 10

Convex Area vs. Perimeter



[66]:
```
options(repr.plot.width = 15, repr.plot.height = 30)
plot_grid(plot2.1, plot2.2,
          plot2.3, plot2.4,
          plot2.5, plot2.6,
          plot2.7, plot2.8,
          plot2.9, plot2.10,
          plot2.11, plot2.12, ncol = 2)
```

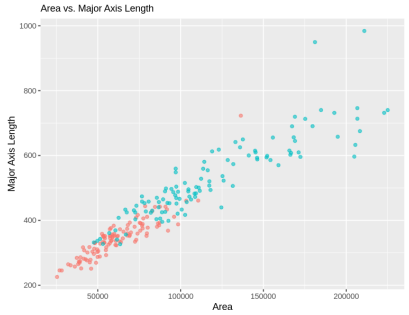


Figure 7
Area vs. Convex Area

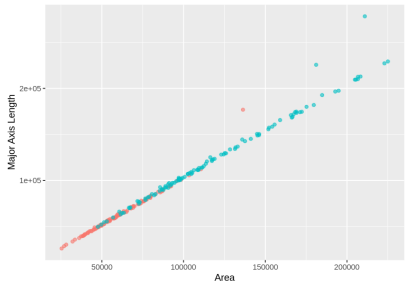


Figure 7
Area vs. Convex Area

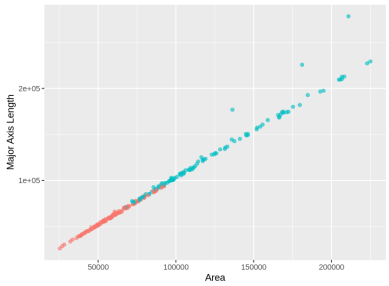


Figure 8
Area vs. Perimeter

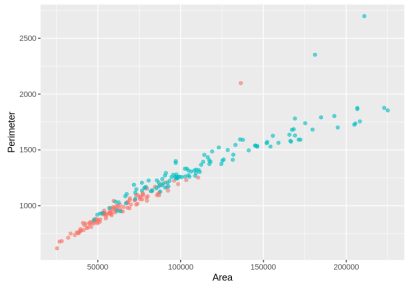


Figure 8
Area vs. Perimeter

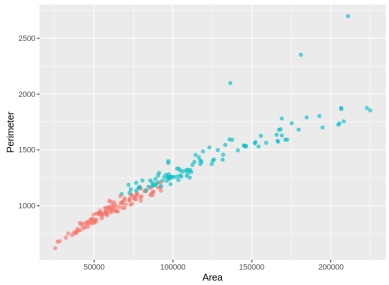


Figure 9
Major Axis Length vs. Convex Area

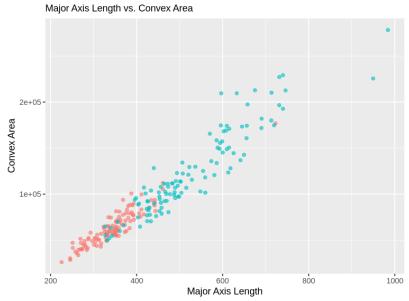


Figure 9
Major Axis Length vs. Convex Area

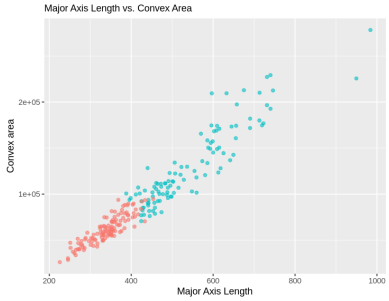


Figure 9
Major Axis Length vs. Perimeter

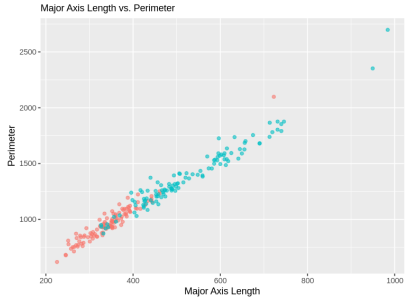


Figure 9
Major Axis Length vs. Perimeter

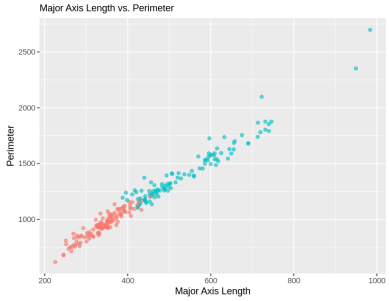


Figure 10
Convex Area vs. Perimeter

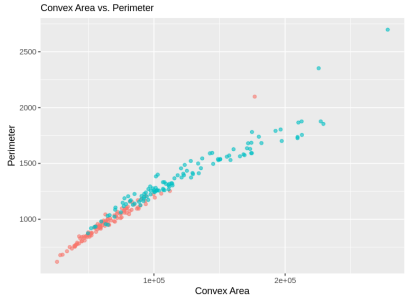
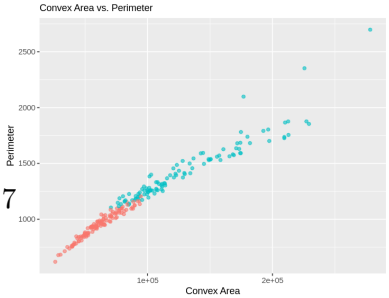


Figure 10
Convex Area vs. Perimeter



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