**Fishing Fisher's Flower Figures - An exploration of the Iris Dataset**

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**Abstract**

This report explores the Iris dataset using data analytics techniques. The Iris data consists of 50 samples from three species of Iris namely Iris Setosa, Iris Virgincia and Iris Versicolor. It consisted of measures of the flowers sepal and petals’ length and width in centimetres. The dataset was analysed using three approaches, descriptive statistics, graphical visualisations and inferential statistics. The method used was statistical analysis using python and python modules. Results showed clear differences between one species and the other two when the data was unlabelled and a third cluster of data when all Iris species were labelled.

**Introduction**

The Iris data set, also known as Fisher or Anderson’s Iris flower data set, was popularised by the statistician Ronald Fisher in his 1936 paper “The use of multiple measurements in taxonomic problems” (Fisher 1936). It was collected by the American botanist, Edgar Anderson in 1935 yet remained unpublished till Fisher published it in his 1936 paper (ibid). Anderson’s data consisted of fifty samples each, from the three species of Iris, Iris Setosa, Iris Virginica and Iris Versicolor. Two of the species, Iris Virginica and Iris Setosa, were sampled from the same region while the Iris Versicolor was sourced elsewhere.

The data was used by Fisher to illustrate discriminant functions (ibid). In addition Fisher extended this method to investigate Randolph’s hypothesis that the third species, Iris Versicolor, was a hybrid of the Iris Virginica and Setosa species (ibid). Anderson recorded five measures, the species type and its corresponding length and width of its petals and sepals. Measures were taken in centimetres (cm). The petals are the inner flower while the sepals protect the emerging flower on the outer part of the plant structures as seen in figure 1. Hence plant sepals are present for a greater time span than the petals.

*Figure 1: Sepal and Petal of the Iris Versicolor*

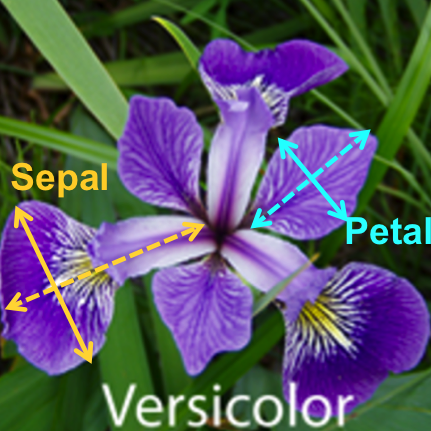


Figure 2, figure 3 and figure 4 are pictures of the flowering Iris Setosa, Iris Virginica and Iris Versicolor respectively.

*Figure 2: Iris Setosa*



*Figure 3: Iris Virginica*



*Figure 4:* *Iris Versicolor*



Thus the data Anderson collected consisted of five dimensions, namely 4 one dimensional measures in cm, sepal length (sepalL), sepal width (sepalW), petal length (petalL), petal width (petalW); And one categorical dimension of Iris species (name).

This project used the version of the Iris data hosted at UCI machine learning repository (Iris Data set, Iris Data, donated 1988). The UCI version contains two errors from Anderson’s original data which were not amended in the analysis (Bezdek, Keller et al., 1999).

Fisher’s analysis investigated if petal/sepal measurements alone could predict which species of Iris the sample came from (Fisher, 1936). This makes the data useful in many aspects of computer science. For example it can be used to explore machine learning methods, statistical techniques and data visualisation tools. Reasons the Iris data set is used also include the following; The Iris data set is well known, and often cited. Iris Data Set (Donated, 1988) notes 99 citations with citations from as recently as 2005. The set has historical significance, as does Fisher, and is widely recognised in computer science. Fisher’s Iris data set is often used as a learning tool in data analytics. The data is small enough to be manageable for beginners yet sufficiently challenging in what it can reveal. Its historical use means that there is a body of work and continuity based on it, which can be used as a benchmark to test program results and explore data analytic methods.

Fisher's analysis showed two main clusters, with the Iris Setosa petal and sepal measures being smaller than the Iris Virginica. Iris Versicolor was intermediate between the other two species with some overlap of measures with Iris Virginica (ibid). This separation into two groups is an example of unlabelled clustering. Once the samples are labelled by species then three clusters emerged. This project sought to replicate these findings.

This project explored the Iris Data using the programming and scripting language Python Version 3.6. In addition GitHub was as the development platform for this project. Python is fast becoming the standard tool for data analysis. It is free and open source, unlike SPSS or SAS for example. It also has a more intuitive syntax than R for example. In addition Python has a wide selection of modules that can be used to investigate particular aspects of the data. For example the Pandas module offers data frame manipulation and table reading tools; NumPy offers numerical and scientific computing; Matplotlib extends NumPy to include plotting ability and Seaborn extends Matplotlib to allows statistical data to be visualised.

This project aimed to explore the Iris data as hosted at UCI. Firstly descriptive data was calculated using Python. This included the maximum, minimum and mean of the petal and sepal measures for each of the species of Iris. Then various visualisations were produced. Finally introductory inferential statistics were investigated to explore if there was significant differences between the Iris species.

**Method**

This report produced descriptive, inferential and graphical visualisations of the Iris data set as hosted at UCI (Iris Data, Donated 1988).

#### Data

This project used a copy of the Iris dataset available from UCI (Data Set, Donated 1988). A sample of which can be viewed below in Table 1a. The full table is available in [Table 1](#table1) ([Appendix 1](#appendix1)). The column headings are as follows; sepalL represents the sepal lengths, sepalW represents sepal widths, petal represents petal lengths, petalW represents petal widths and name represents the iris species, Iris-setosa, Iris-versicolor and Iris-virginica. All measures are in cm.

*Table 1a*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | sepalL | sepalW | petalL | petalW | name |
| 0 | 5.1 | 3.5 | 1.4 | 0.2 | Iris-setosa |
| 1 | 4.9 | 3.0 | 1.4 | 0.2 | Iris-setosa |
| 2 | 4.7 | 3.2 | 1.3 | 0.2 | Iris-setosa |
| 3 | 4.6 | 3.1 | 1.5 | 0.2 | Iris-setosa |
| 4 | 5.0 | 3.6 | 1.4 | 0.2 | Iris-setosa |
| 5 | 5.4 | 3.9 | 1.7 | 0.4 | Iris-setosa |
| 6 | 4.6 | 3.4 | 1.4 | 0.3 | Iris-setosa |
| 7 | 5.0 | 3.4 | 1.5 | 0.2 | Iris-setosa |
| 8 | 4.4 | 2.9 | 1.4 | 0.2 | Iris-setosa |
| 9 | 4.9 | 3.1 | 1.5 | 0.1 | Iris-setosa |

#### Apparatus and Materials

A computer with Python 3.6 software installed was used. An internet connection was required for conducting research. In addition the python modules, NumPy, Pandas, Matplotlib and Seaborn were used. GitHub in conjunction with Visual Studio Code was used for program development.

#### Procedure

The data was downloaded from UCI Iris.csv (Data Set, Donated 1989) as a cvs file and stored in a local folder as project /data/Iris.csv. The Python module Pandas was used to import the data as a dataframe and to perform initial descriptive analysis. Firstly the shape of the data was looked at and the first 10 entries. Then descriptive statistics were produced for each species of Iris (length/width ratios, mean, maximum and minimum values of the measures).

Then the data explored using visualisation techniques including scatter plots, box plots and various density plots. The data was visualised using the NumPy extension modules Matplotlib and Seaborn.

Inferential statistics Student’s t-test for comparing two means from normal distribution and independent variances and Welch’s adaption of Student t-test when variances are not independent.

**Results**

#### *Descriptive statistics*

The descriptive statistics were taken by running the script project/pyscripts/desc.py. Results were saved in folder project/data/ with data from desc\_se.csv shown in table 2; desc\_vi shown in table 3 and desc\_ve shown in table 4.

*Table 2:* *Iris Setosa descriptive statistics*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Setosa cm | sepalL | sepalW | petalL | petalW |
| count | 50 | 50 | 50 | 50 |
| mean | 5.006 | 3.418 | 1.464 | 0.244 |
| std | 0.352 | 0.381 | 0.174 | 0.107 |
| min | 4.3 | 2.3 | 1 | 0.1 |
| 25% | 4.8 | 3.125 | 1.4 | 0.2 |
| 50% | 5 | 3.4 | 1.5 | 0.2 |
| 75% | 5.2 | 3.675 | 1.575 | 0.3 |
| max | 5.8 | 4.4 | 1.9 | 0.6 |

This shows that the Setosa data consisted of 50 samples with measures taken of the Iris’s sepal and petals length and width. The mean was smallest for the petals, with the width having the smallest mean (0.244cm). The sepal length had the highest mean (5.006cm) and was over three times larger than the petals length (1.464cm). Although the sepal mean width (3.418cm) was smaller than its mean length (5.006cm), it was over 14 times bigger than the corresponding mean width for the petals (0.244cm). The sepal length had the largest maximum (5.8cm) and minimum value (4.3cm) of all the measures while the petal width showed the smallest maximum (0.6cm) and minimum (0.1cm) value. The standard deviation (std) showed that the sepal values (length - 0.352 and width -0.381) were more spread out than the petal values (length 0.174 and width 0.107). The table also shows the percent quartiles.

*Table 3* *Iris Virginica descriptive statistics*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Virginica cm | sepalL | sepalW | petalL | petalW |
| count | 50 | 50 | 50 | 50 |
| mean | 6.588 | 2.974 | 5.552 | 2.026 |
| std | 0.636 | 0.322 | 0.552 | 0.275 |
| min | 4.9 | 2.2 | 4.5 | 1.4 |
| 25% | 6.225 | 2.8 | 5.1 | 1.8 |
| 50% | 6.5 | 3 | 5.55 | 2 |
| 75% | 6.9 | 3.175 | 5.875 | 2.3 |
| max | 7.9 | 3.8 | 6.9 | 2.5 |

For the 50 Iris Virginica samples, the mean was smallest for the petal width (2.026cm) and largest for the sepal length (6.588cm) as per the Iris Setosa. The maximum (highest at 7.9cm for sepal length and lowest at 2.5cm for petal width) and minimum (highest at 4.9 for sepal length and lowest at 1.4cm for petal width) were higher than the Iris Setosa’s but showed the same pattern of the sepals being longer and wider with the exception of the sepal width. The spread of the data was greater than the Iris Setosa over all measures excepting the sepal width which were smaller (2.2cm minimum and 3.8cm maximum). All quartiles except the sepal width were greater than the Iris Setosa quartiles.

*Table 4* Iris Versicolor descriptive statistics

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Versicolor cm | sepalL | sepalW | petalL | petalW |
| count | 50 | 50 | 50 | 50 |
| mean | 5.936 | 2.77 | 4.26 | 1.326 |
| std | 0.516 | 0.314 | 0.470 | 0.198 |
| min | 4.9 | 2 | 3 | 1 |
| 25% | 5.6 | 2.525 | 4 | 1.2 |
| 50% | 5.9 | 2.8 | 4.35 | 1.3 |
| 75% | 6.3 | 3 | 4.6 | 1.5 |
| max | 7 | 3.4 | 5.1 | 1.8 |

For the 50 Iris Versicolor samples, the means for the petal dimensions (4.26cm length, 1.326cm width) were smaller compared to the corresponding means for the sepals (5.936cm length, 2.77cm width). The largest mean was for the sepal length (5.936cm) and smallest for the petal width (1.326cm) with the values falling between the lower Setosa measures and higher Virginica ones. The maximum value was the sepal length (7cm) which was just under the maximum for the Virginica species (7.9cm). The minimum measure was the petal width (1cm) similar to the other Iris species. The measure of spread for the Iris Versicolor (0.516 for sepal length, 0.314 for sepal width, 0.470 for petal length, 0.198 for petal width) was slightly lower for the corresponding values for the Iris Virginica (0.636, 0.322, 0.522, 0.275 respectively) but higher than the Iris Setosa (0.352 , 0.381 , 0.174, 0.107, respectively) The quartiles lay between the lower Setosa and higher Virginica except for the Sepal width which had the lowest quartiles (25% at 2.525, 50% at 2.8 and 75% at 3) out of all the samples.

The ratio of sepal length to width and petal length to width were also calculated as seen in table 6

*T**able 6* Ratios of Length to Widths of Iris Data

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Ratio L/W | Setosa  Sepal | Setosa  Petal | Vericolor  Sepal | Vericolor  Petal | Virginica  Sepal | Virginica  Petal |
| count | 50 | 50 | 50 | 50 | 50 | 50 |
| mean | 1.475 | 7.078 | 2.160 | 3.243 | 2.230 | 2.781 |
| std | 0.119 | 3.124 | 0.229 | 0.312 | 0.247 | 0.407 |
| min | 1.268 | 2.667 | 1.765 | 2.667 | 1.824 | 2.125 |
| 25% | 1.395 | 4.688 | 2.034 | 3.017 | 2.032 | 2.511 |
| 50% | 1.468 | 7.000 | 2.161 | 3.240 | 2.170 | 2.667 |
| 75% | 1.548 | 7.875 | 2.232 | 3.418 | 2.343 | 3.056 |
| max | 1.957 | 15.0 | 2.818 | 4.1 | 2.962 | 4.0 |

This shows that the Setosa petal ratio had the largest length to width mean ratio at 7.078 whist the Setosa sepal ratio had the smallest length to width ration 1.475. The Versicolor and Virginia had comparable ratios ranging between lengths being twice as big as widths to lengths being under 4 times as big as widths.

#### *Visualisations*

##### Scatter plots

Visualisations of the data were produced by running /project/pyscripts/visu.py. Results were saved in /project/graphs/. Figure 5 and 6 shows the initial scatter plot of the sepal measures and petal measures respectively via matplotlib.pyplot. Script figures are saved in the folder project/graphs/ see project/readme.md for list of graphs

.

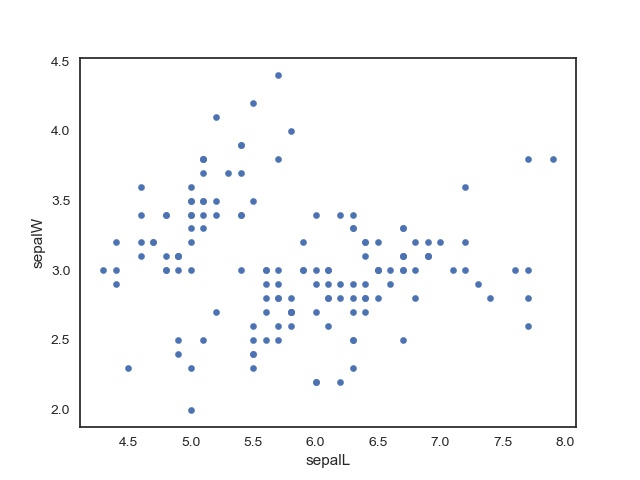
*Figure 5* *Scatter plot of the Iris’s sepal length versus widths in cm*

Figure 5 shows the scatter plot of all the data without labelling it by species. This shows that sepal lengths tend to be greater than sepal widths. The figure also suggests that sepal widths are negatively correlated to lengths. The data also suggests smaller lengths have a steeper incline compared to larger lengths. Figure 6 shows the corresponding plot of the petal lengths.

*Figure 6* *Scatter plot of the Iris’s sepal length versus widths in cm*

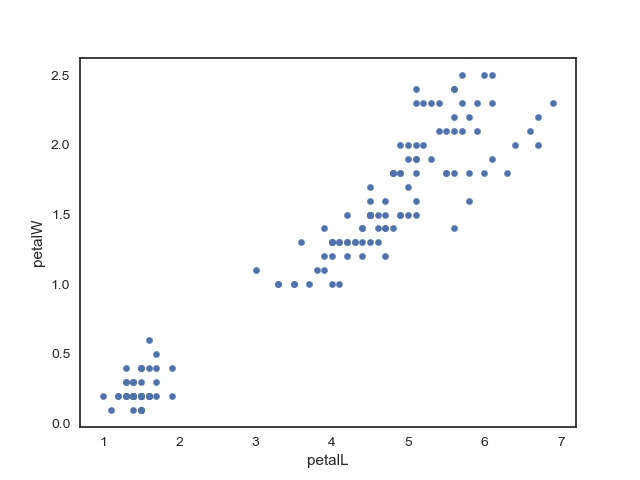


Figure 6 shows a similar pattern of lengths being greater than widths. However here, larger lengths tend to have larger widths. Two distinct clusters appear to be present, a small tight cluster in the lower left of the scatter plot and a larger more dispersed cluster in the middle to upper right of the scatter plot. The data appears to have a strong liner relationship and a high positive correlation between petal lengths and widths.

*Figure 7 scatter plot of sepal lengths and widths in cm with correlation*

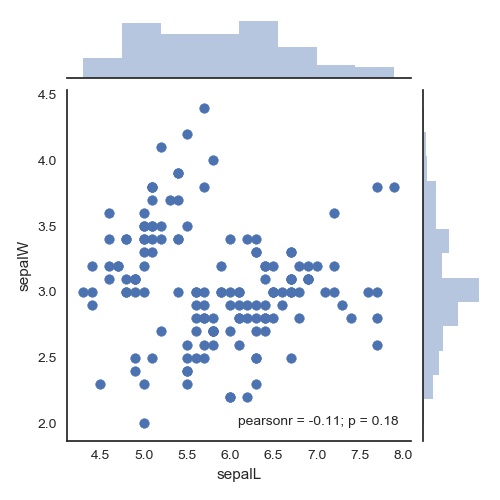


Figure 7 and 8 were produced using the seaborn module which produces a scatter plot that also calculates Pearsons correlation coefficient r. Figure 7 shows the scatter plot for sepeal lenghts and widths. This shows Pearson’s r as -0.11 indicating a very slight negative corralation between sepal lengths and widths. However the association is not signifigiant as shown by the p vlaue of 0.18 > 0.05;

*Figure 8* *scatter plot of petal lengths and widths in cm with correlation*

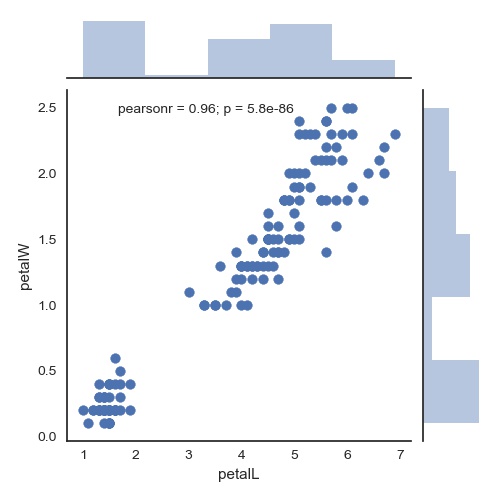
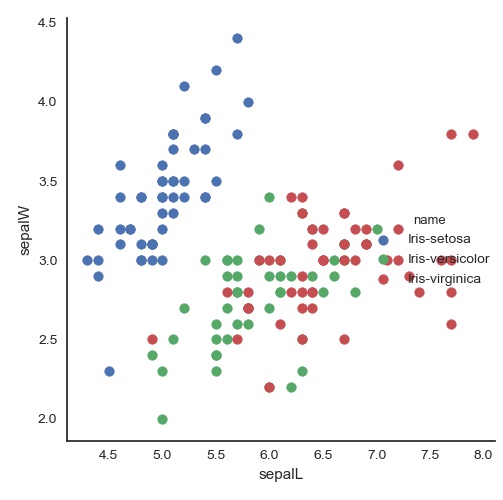


Figure 8 shows Pearson’s r at 0.96 indicating an almost perfectly positive linear relationship between petal lengths and widths. The association is significant as the p value is less than 0.05.

The seaborn module was also used to explore this difference between sepals and petals by identifying each Iris species within the scatter plot as shown in Figures 9 and 10.

*Figure 9* *scatter plot of sepal lengths and widths in cm labelled by Iris name*



This shows a clear cluster amongst the Iris Setosa (in blue) in sepal dimensions, in the mid to upper left of the graph. The Iris Setosa appears to show a strong positive correlation in sepal length to width dimensions that is absent in the other two species.

Clusters are less pronounced between the Iris Versicolor (green) and Iris Virginica (red) although it appears that the Virginica have larger sepal dimensions than the Versicolor with some degree of overlap around the (6.25, 2.75) position. The lengths and widths also appear to be positively correlated for Virginica and Versicolor but to a far lesser degree than with the Setosa dimensions.

*Figure 10* *scatter plot of petal lengths and widths in cm labelled by Iris name*

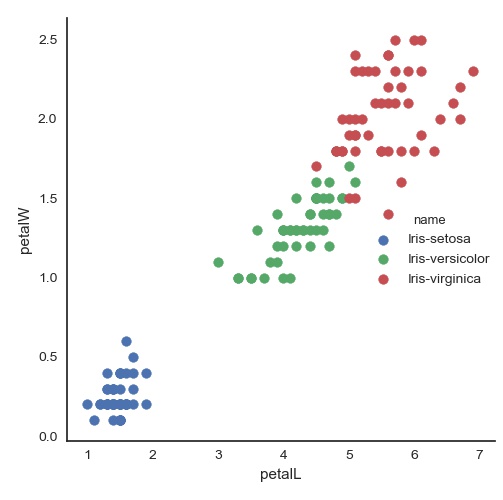


Figure 10 clearly shows three clusters with the petals. The Iris Setosa has clearly smaller petal dimensions than the other two, with the Iris Versicolor falling linearly between the Iris Setosa and Iris Virginica with some overlap between larger Versicolor petals and smaller Virginica petals. There is no overlap in petal measures between the Setosa and the other two Iris species.

##### Box plots

Figures 11-15 show the box plots of the sepal and petal lengths and widths sorted by Iris name.

*Figure 11* Boxplot of sepal lengths cm

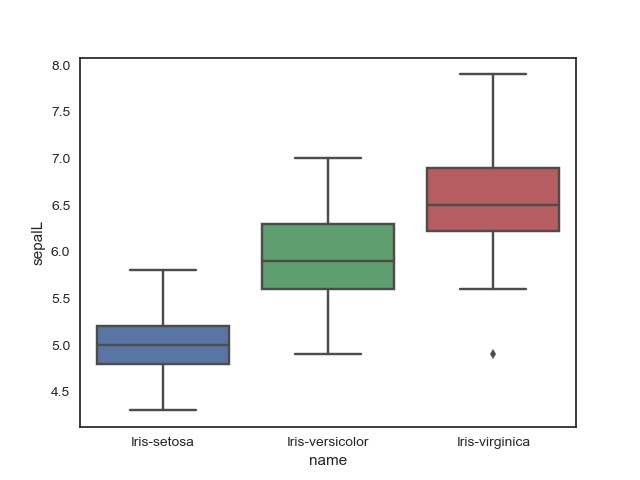


Figure 11 shows that sepal length quartiles are smallest for the Iris Setosa and largest for the Iris Virginica with the Iris Versicolor falling between them. The quartile spread is similar for the Iris Virginica and Iris Versicolor while narrower and more symmetrical for the Iris Setosa. The maximum value of the Iris Setosa and the minimum of Iris Virginica barely overlap. The maximum value of the Iris Virginica is further from its median compared to the other species of Iris.

*Figure 12* *Boxplot of sepal widths cm*

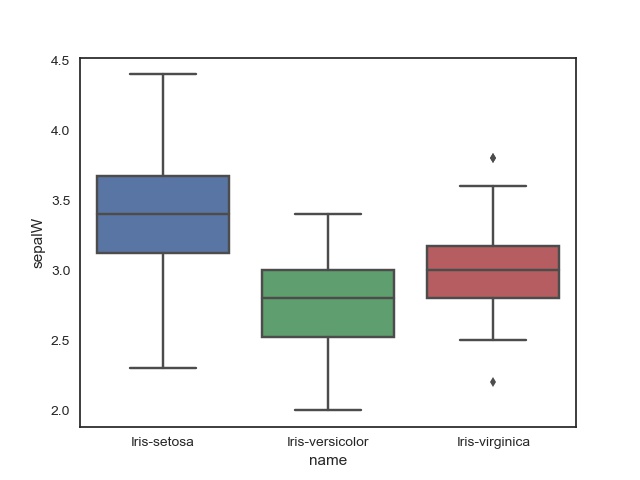


Figure 12 showed that the Iris Setosa width has the larger quartiles compared to the other two with a greater spread between its maximum and minimum. The Iris Veriscolor has the lowest quartiles while the Iris Virginica lies between the Iris setosa and Iris versicolor. The Iris Virginica also shows outliers in its highest and lowest sepal width. The range of sepal widths for the Iris Setosa encompasses all the Iris Virginica measures and the maximum and quartile span of the Iris Versicolor, with only Versicolor values close to the minimum falling outside of the Setosa’s range.

*Figure 13* *Boxplot of petal lengths cm*

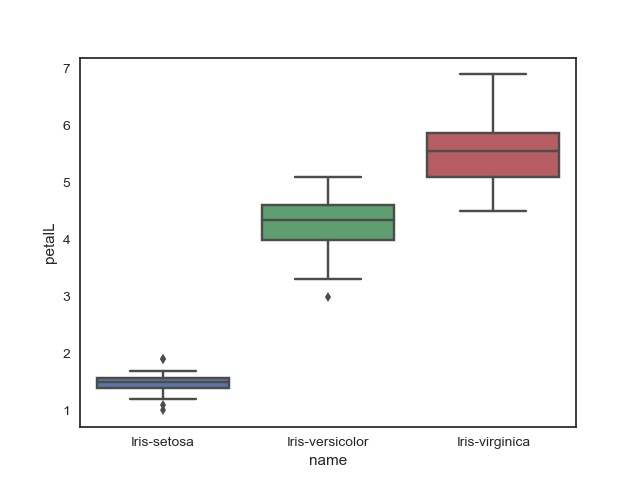


Figure 13 shows a great deal of separation between the Iris Setosa petal lengths and the other two species, with some outliers in its highest and lowest lengths. Iris Versicolour petal lengths fall between the smaller Iris Setosa and larger Iris Virginica, with no overlap with the former and some overlap between the upper Versicolor values and the mid to lower Virginica values. Some separation between the Iris Versicolor and Iris Virginica was present as the Versicolor quartiles were lower than the Virginicas’ first quartile. In addition, the Iris Versicolor petal length maximum value is below the Iris Virginica’s median petal length. There is also an outlier low value in the Iris Versicolor and low and high outliers in the Iris Setosa petal length.

*Figure 14* *Boxplot of petal widths cm*

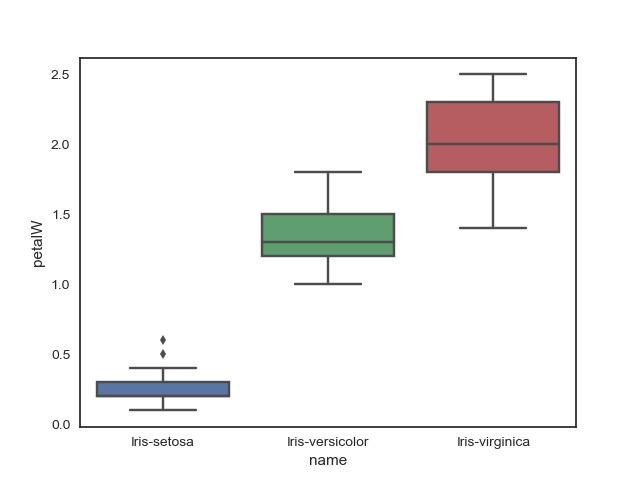


Figure 14 shows a similar pattern in petal widths as found in petal lengths. There is stronger separation between petal widths of the Iris Versicolor and Iris Virginica as the maximum value of the former is just over the first quartile of the later. There is no overlap between these two and the Iris Setosa. The Setosa also showed the presence of two outliers at the upper widths.

Figures 15-18 show the boxplot overlaid with the split plot to show the distribution of data over its boxplot measures.

*Figure 15* *Boxplot spilt plot overlay of sepal lengths in cm*

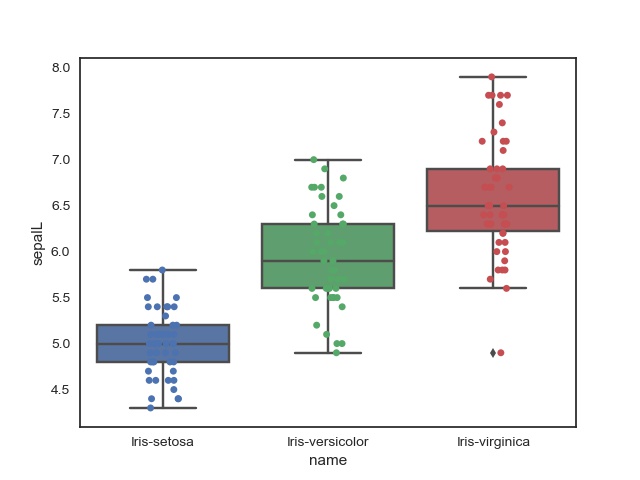


Figure 15 appears to show distribution density along within the quartiles for the Iris

Setosa sepal lengths with less distribution within this band for the Iris versicolor. The Iris Virginica appears to show comparable distribution outside the quartiles as between them.

*Figure 16* *Boxplot spilt plot overlay of sepal widths in cm*

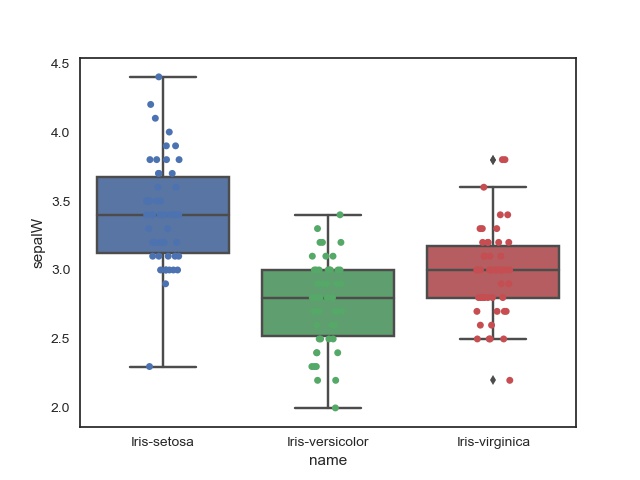


Figure 16 shows the distribution of the Iris Setosa sepal widths are clustered between the upper and lower quartile whereas the dispersion appears to be more uniform between the minimum and maximum values for the other two species. The Setosa spread shows a longer tail at the upper width values.

*Figure 17* *Boxplot spilt plot overlay of petal lengths in cm*

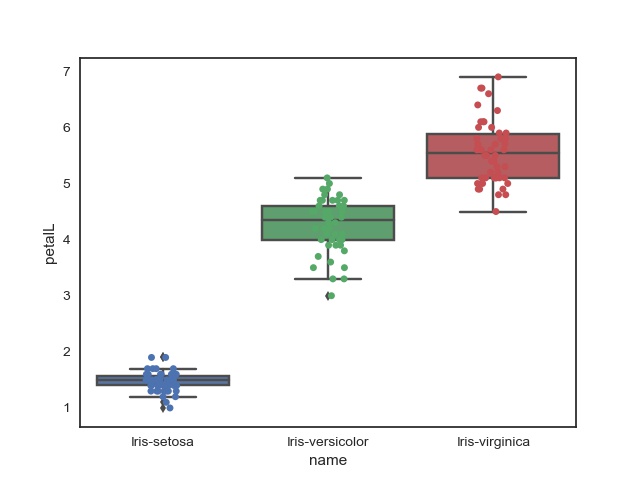


Figure 17 shows the distribution of Iris Setosa petal lengths are focused between the narrow range of its maximum and minimum length as are the other two albeit within a larger range. The Iris Versicolor petal lengths are dispersed between the lower quartile and maximum whereas the Iris Virginica show clustering within the upper and to just under the lower quartile.

*Figure 18* *Boxplot spilt plot overlay of petal widths in cm*

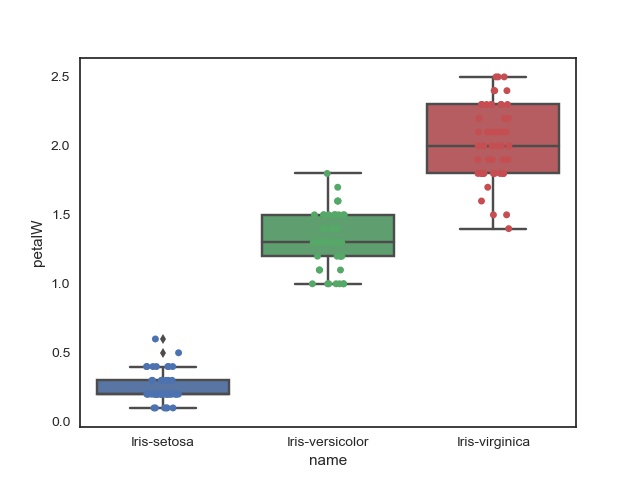


Figure 18 shows clustering of the Iris Versicolor within its upper and lower quartile but with several samples at the minimum petal width. The Iris Setosa petal widths are also focused between the narrow range of quartiles and then at the maximum and minimum. The Iris Virginia has the greatest spread and highest values of petal width.

##### Density plots

Figures 19 to 22 show the violin plots of the data which incorporates box plot details with the data’s density distribution.

*Figure 19* *Violin plot of sepal lengths in cm*

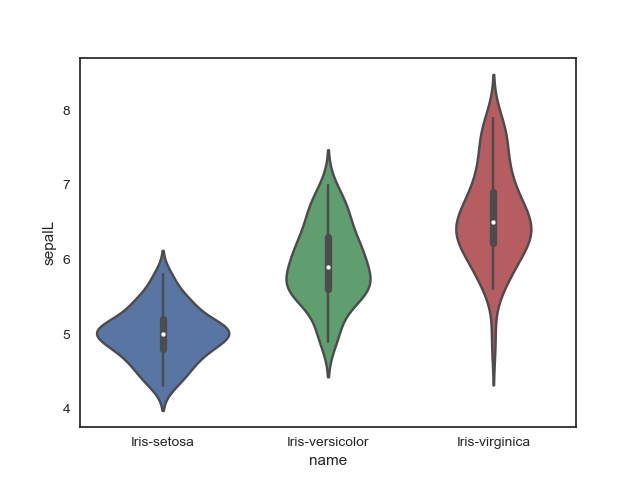


Figure 19 shows the distribution in sepal lengths for all the species is symmetrical with most values focusing round the mean (the central bulge) as in a normal distribution. The Iris Setosa shows a wide area around the mean indicating a higher probability that more samples from the Iris Setosa will have a value close to this mean. The Iris Versicolor plot indicates that further samples would fall just below the mean. However both the Iris Versicolor and Iris Virginica are narrower than the Iris Setosa, suggesting the distribution is wider than for the Setosa. The sepal lengths of the Iris Virginica show a long narrow tail for the smaller sepal lengths and slightly thicker tail for the upper sepal lengths. This suggests the density is quite dispersed. The Versicolor is not as spread out as the Virgnica and the Setosa is quite compact.

*Figure 20* *Violin plot of sepal widths in cm*

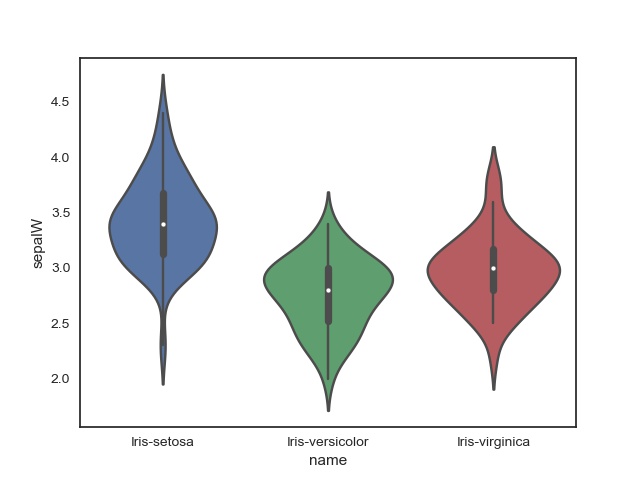


Figure 20 shows the violin plot of sepal widths. This shows a similar pattern in terms of symmetrical density around the mean, however the Setosa widths show a long tail in the lower sepal widths. The density around the mean is less pronounced in the Setosa sepal widths than it was in their lengths. Whereas the pattern is reversed with the other two as the area around their mean is more pronounced than it was with lengths. The Setosa has the highest values, then the Virginica and the Versicolor has the lowest measures in sepal widths.

*Figure 21* *Violin plot of petal lengths in cm*

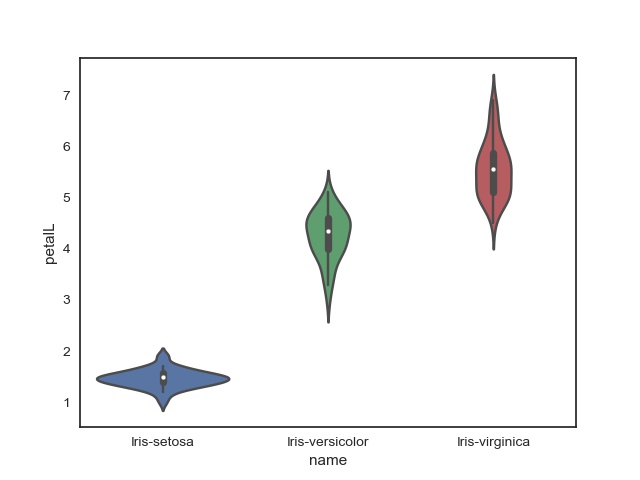


Figure 21 shows the Violin plot of petal lengths. This shows that that the data is broadly symmetrical with a bulge around the mean suggesting a normal distribution as before. The Iris Setosa central density is quite pronounced. The Iris Versicolor has a long tail at the lower petal lengths and the opposite pattern with a long tail in the upper petal lengths was found in the Iris Verginica. Both the Iris Versicolor and Iris Virginica are of broadly similar shape whereas the Iris Setosa appears to be from a different normal distribution.

*Figure 22 Violin plot of petal widths in cm*

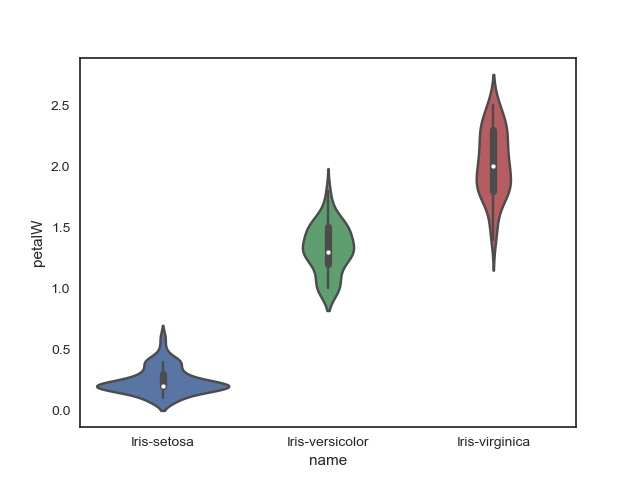
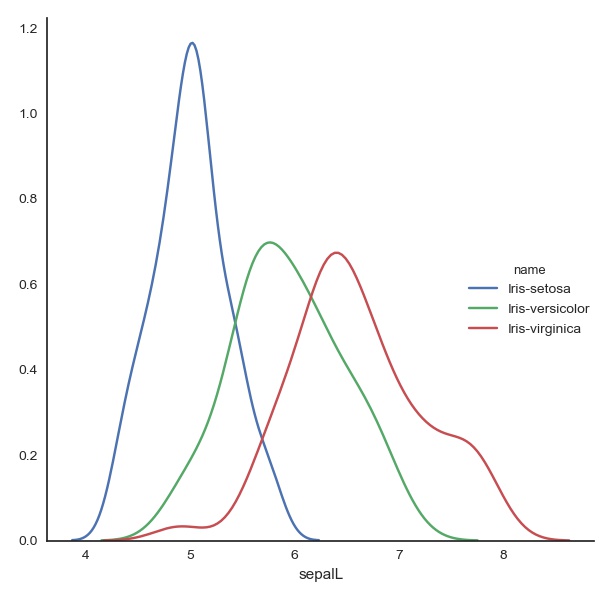


Figure 22 shows the violin plots for the petal widths. All plots look symmetrical however there appears to be a bimodal distribution in the Iris Setosa with a large density around the mean but another density developing in the upper petal widths. The Iris Versicolor shows a much milder version of this bimodality at the lower width values.

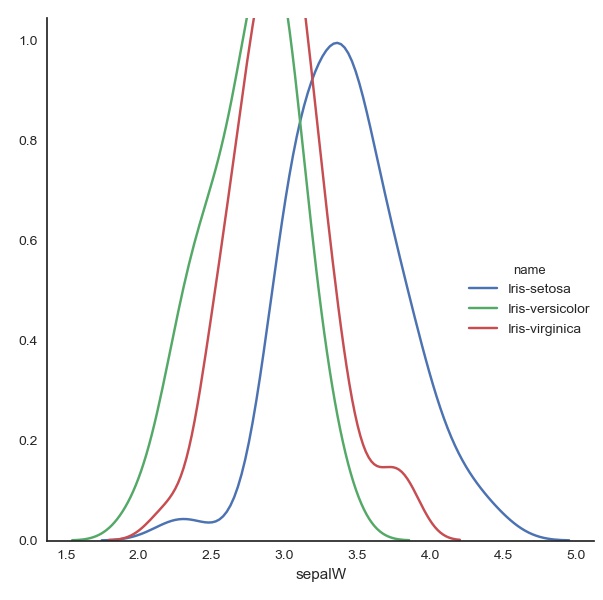
Figures 23 to 25 show the kde plot of the Iris data.

*Figure 22* *kde plot of Iris sepal lengths*



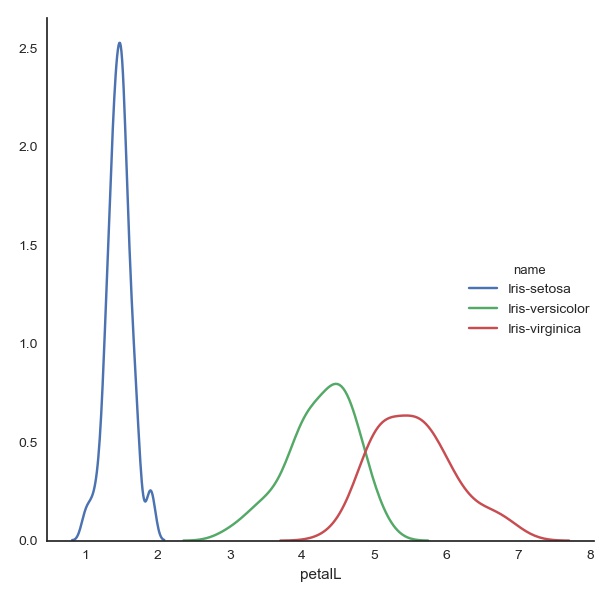
This shows that each of the species appears to have normally distributed sepal lengths with the distributions of the Iris Setosa differing from the more similar Versicolor and Virginica. The Setosa’s mean peak is higher than the similar apexes of the other two.

*Figure 23* kde plot of Iris sepal widths



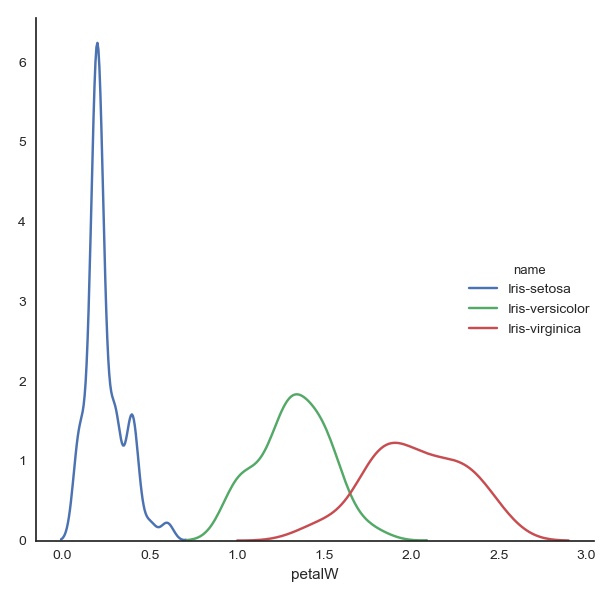
This shows a similar pattern to the sepal lengths with data looking normally distributed however the plot of the Setosa’s sepal widths is now the smallest. The graphs all look to be of comparable thickness.

*Figure 24* kde plot of Iris petal lengths



This shows that the kernel density estimation is similar for the Versicolor and Virginica with overlapping populations. Whereas the Setosa has a different shape and a small peak at its upper values.

*Figure 25* kde plot of Iris petal widths



This shows the kde plot of Iris petal widths. The data is not as clearly normally distributed as for the other measures. In particular the small peak in the petal lengths is more pronounced in the petal widths. The Versicolor and Virginica also show very slight bimodal humps at the lower widths and upper widths respectively.

Figure 26 and 27 show the pair plots of the bivariate relationship between each pair of features. Figure 26 shows histograms along the diagonal and figure 27 shows kde plots along the diagonal.

*Figure 26* pairplot of bivariate relations of the Iris data with histogram along the diagonal

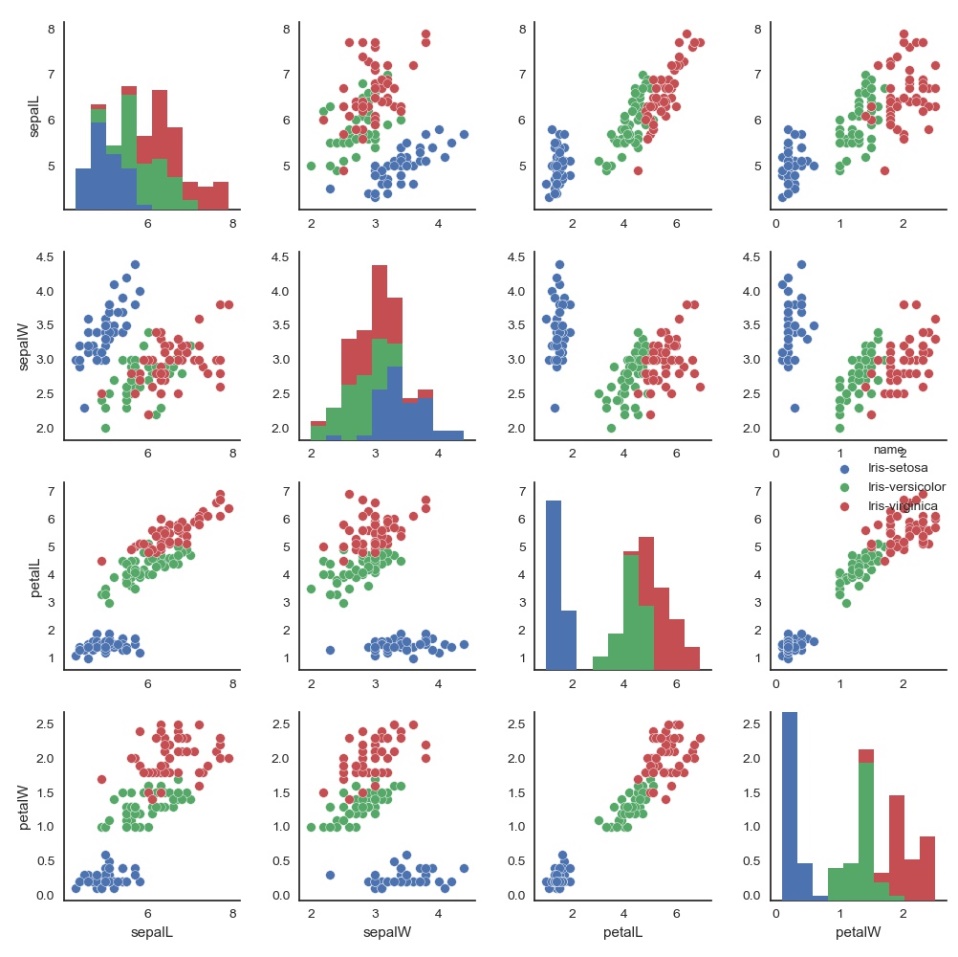
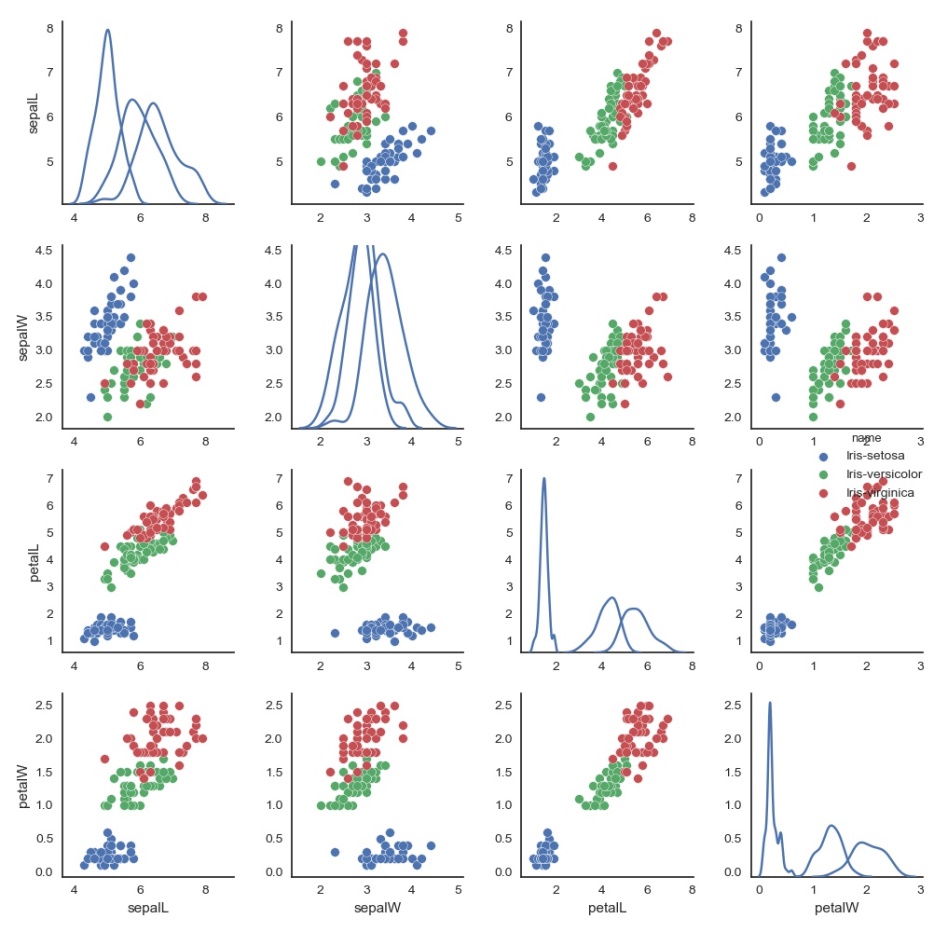


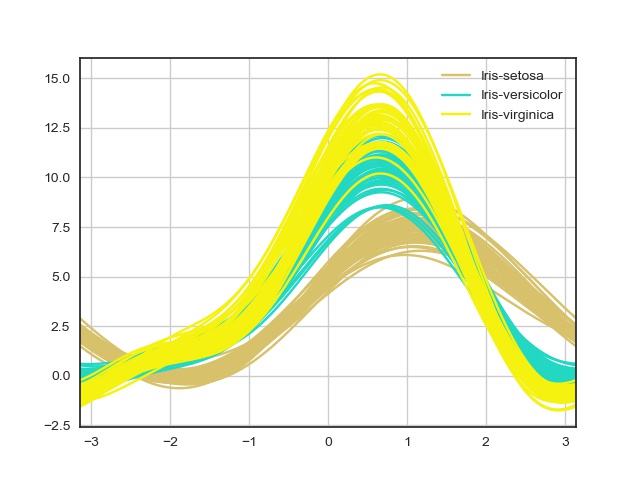
Figure 26 with histograms along the diagonal, shows each measure plotted against the other measures. In each case the Setosa cluster remains clear with the Versicolor and Virginica cluster emerging strongest with petal lengths (3rd column and 3rd row). The Versicolor and Virginica cluster appears weakest when comparing sepal widths.

*Figure 27* pairplot of bivariate relations of the Iris data with kde plot along the diagonal



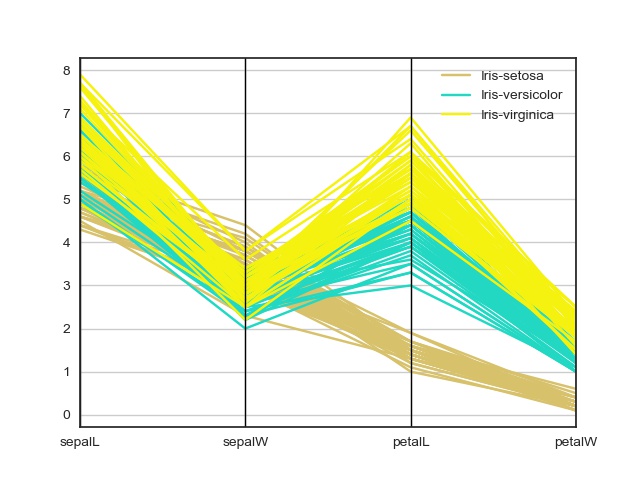
This shows…god with the graphs never end…

*Figure 30* Andrew Curves plot of Iris data



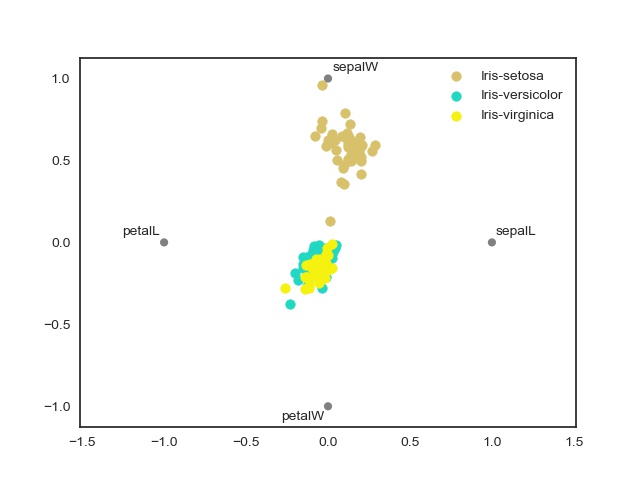
This shows something to do with fourier transformations…don’t know what yet or how to interpret graph…god I hope this is the last graph.

*Figure 3*1 Parallel Coordinates plot of Iris data



This shows…the iris set differs crossing over at the sepal width….. ahhhh.

Figure 32 Radviz plot of Iris data



This shows….

#### *Inferential* *statistics*

##### Comparing sepal widths

A one way t-test between the Iris setosa and Iris versicolor sepal widths was conducted. This tested if there is a significant difference in sepal widths between the Iris setosa and Iris versicolor. The Iris setosa’s average sepal width (M=3.418 , SD= 0.377) is wider and has greater variation than Iris versicolor (M= 2.77, SD=0.311). Levene’s test for homogeneity of variances indicated equality of variance (F=1.057 *, p=0.306*); therefore an Independent t-test was used. Results showed a significant difference in sepal widths between Iris-setosa and Iris-versicolor (t(98)=9.283, *p=4.362e-15*).

A one way t-test between the Iris setosa and Iris virginica sepal widths was conducted. This tested if there is a significant difference in sepal widths between the Iris setosa and Iris virginica. The Iris setosa’s average sepal width (M=3.418 , SD=0.377 ) is wider and has slightly greater variation than Iris-virginica (M= 2.974, SD=0.319). Levene’s test for homogeneity of variances indicated equality of variance (F= 0.967, p=0.181); therefore an Independent t-test was used. Results showed a significant difference in sepal widths between Iris-setosa and Iris-virginica (t(98)=6.289, p=8.917e-09).

A one way t-test between the Iris versicolor and Iris virginica sepal widths was conducted. This tested if there is a significant difference in sepal widths between the Iris versicolor and Iris virginica. The Iris versicolor’s average sepal width (M=2.77 , SD=0.311 ) is shorter slightly smaller variation than Iris-virginica (M=2.974 , SD=0.319). Levene’s test for homogeneity of variances indicated equality of variance (F=0.087 , p=0.768); therefore an Independent t-test was used. Results showed a significant difference in sepal widths between Iris-versicolor and Iris-virginica (t(98)=3.206, p=0.002).

##### Comparing sepal lengths

This test investigated there is a significant difference in sepal lengths between the Iris setosa and Iris versicolor. The Iris setosa’s average sepal length (M=5.006, SD=0.349) is smaller and has less variation than Iris-versicolor (M=5.936 , SD=0.511). Levene’s test for homogeneity of variances was significant (F=8.172, p<0.05); therefore Welch's t-test was used. Results showed a significant difference in sepal widths between Iris-setosa and Iris-versicolor (t(86.538)=-10.521, p<0.05).

This test investigated if there is a significant difference in sepal lengths between the Iris setosa and Iris virginica. The Iris setosa’s average sepal length (M= 5.006, SD=0.349) is smaller and has less variation than Iris-virginica (M=6.588 , SD=0.629). Levene’s test for homogeneity of variances was significant (F=11.454 , p=0.001); therefore Welsh's t-test was used. Results showed a significant difference in sepal lengths between Iris setosa and Iris-virginica (t(76.516)=-15.386, p<0.05).

This test investigated if there is a significant difference in sepal lengths between the Iris versicolor and Iris virginica. The Iris versicolor's average sepal length (M=5.936 , SD=0.511 ) is shorter and has slightly less variation than Iris-virginica (M=6.588 , SD=0.629). Levene’s test for homogeneity of variances indicated equality of variance (F=1.025, p=0.314); therefore an Independent t-test was used. Results showed a significant difference in sepal widths between Iris-versicolor and Iris-virginica (t(98)=-5.629, p=1.725e-07).

##### Comparing petal widths

This tested if there is a significant difference in petal widths between the Iris setosa and Iris versicolor. The Iris setosa’s average petal width (M= 0.244, SD=0.106) is wider and has less variation than Iris-versicolor (M=0.106 , SD=1.326 ). Levene’s test for homogeneity of variances was significant and both the setosa and versicolor failed the Shapiro Wilk test for normal distribution. Thus the t test was not conducted.

This tested if there is a significant difference in petal widths between the Iris setosa and Iris virginica. The Iris setosa’s average petal width (M=0.244, SD=0.106 ) is smaller and has less variation than Iris-virginica (M=2.026 , SD=0.272). Levene’s test for homogeneity of variances was significant (F=38.107, p=1.517e-8); The Shapiro Wilk for the Iris setosa petal widths was significant (F=0.814, p=1.853e-06) whereas the Shapiro Wilk test for the Iris Virginica was not significant (F=0.960, p=0.09) therefore no t-test was performed.

This tested if there is a significant difference in petal widths between the Iris versicolor and Iris virginica. The Iris versicolor's average petal width (M=1.326 , SD=0.196) is smaller and has less variation than Iris-virginica (M=2.026 , SD=0.272). Levene’s test for homogeneity of variances was significant (F=6.546, p=0.012); therefore Welch's t-test was used. Results showed a significant difference in petal widths between Iris-versicolor and Iris-virginica (t(89.043)=-14.625, p<0.05).

##### Comparing petal lengths

This tested if there is a significant difference in petal lengths between the Iris setosa and Iris versicolor. The Iris setosa’s average petal length (M=1.464 , SD=0.172 ) is smaller and has less variation than Iris-versicolor (M=4.26, SD=0.465 ). Levene’s test for homogeneity of variances was significant (F=30.897, p=2.348); therefore an Independent t-test was used. Results showed a significant difference in petal lengths between Iris-setosa and Iris-versicolor (t(62.118)=-39.469, p<0.05).

This tested if there is a significant difference in petal lengths between the Iris setosa and Iris virginica. The Iris setosa’s average petal length (M=1.464 , SD= 0.172) is much smaller and has less variation than Iris-virginica (M=5.552, SD=0.546). Levene’s test for homogeneity of variances was significant (F=39.977 , p=7.651e-09); therefore an Welch's t-test was used. Results showed a significant difference in petal lengths between Iris-setosa and Iris-virginica (t(58.593)=-49.9657, p<0.05).

This tested if there is a significant difference in petal lengths between the Iris versicolor and Iris virginica. The Iris versicolor's average petal length (M=4.26 , SD=0.465 ) is smaller and has less variation than Iris-virginica (M=5.552 , SD=0.546). Levene’s test for homogeneity of variances indicated equality of variance (F=1.067 , p=0.304); therefore an Independent t-test was used. Results showed a significant difference in petal lengths between Iris-versicolor and Iris-virginica (t(98)=29.023 p=6.428).

**Discussion**

This project analysed the Iris data set.

Add in a paragraph on the description of the whole data. …

Firstly the ratio’s between the length and width was explored. The Setosa sepal ratios were fairly similar with no lengths being more than double the widths. In contrast the Setosa petals lengths varied between double and 15 times larger than the widths. The sepals of both the Versicolor and Virginica also showed this modest pattern with the sepal measures with no lengths being more than 3 times the corresponding width. There was greater similarity between the sepal measures of the Virginica and Versicolor than the smaller ratio between the Setosa measures. The petal length/width ratio for the Virginica and Versicolor were more modest compared to the Setosa petal ratios. No length was greater than just over 4 times its width and averaging at around 3 times the width. Thus the sepal’s appeared more similar across the three species. The petals were comparable between the Virginia and Versicolor but in stark contrast to those of the Setosa. This pattern was illustrated in the scatter plot of the Iris petals figure 6. Figure 6 plotted unlabelled petal measures and strongly indicates the presence of two clusters. Figure 10 is the same scatter plot but with the three species of Iris displayed in differing colours. This plot suggested further clustering, with the Setosa petals tightly bunched in the lower left of the graph, the Versicolor in the middle and the Virginica in the upper left. There was some overlap between the Versicolor and Virginica measures but no overlap of the Setosa and the petals of the other species. XRandolf?X (Ref) suggested that the Versicolor was a hybrid of the Setosa and Virginica and an initial analysis supported this hypothesis as the Versicolor lay between the other two. However Anderson selected the Setosa and Virginica from the same region whereas the Versicolor was collected from a different region. It would be useful to select all the data from one region to investigate if the stratification is more or less pronounced.

The labelled data set shows cluster patterns for both the sepal and petal dimensions. The petal labelled data shows three clusters while the sepal labelled data shows a setosa cluster with the other two species forming the another cluster. The Virginia and Versicolor sepal measures show overlap around the 5.5-6.5cm sepal lengths. This becomes more stratified at the upper and lower extremities with the Virginica tending towards the upper right of the scatter plot and the versicolor along the lower left. However the stratification in sepal measures is far less pronounced than with the petal measures which had far less overlap between the Versicolor and Virginica.

The cluster’s suggested by the descriptive statistics and visualisation of the data set was tested for association. There were significant differences in sepal widths between the setosa and the other two species. There was also a significant difference in sepal widths between the versicolor and virginica. This indicates that the means of the sepal widths of all the species are from different distributions. In these cases the data satisfied the equality of variance criteria for independent t-test. The sepal lengths inferential analysis was not clearly separated as in the case of the Setosa paired with both the Versicolor and Virginica, the independence of variance criteria was not met. Yet there was still a significant difference in the means albeit with less degrees of freedom. The Versicolor and Virginia t-test for sepal length satisfied the equality of variance test and was significant suggesting these came from different normal distributions.

Inferential statistics on petal width showed that the Setosa and Versicolor did not satisfy the criteria for performing Student’s t-test or Welch’s t-test. This would require further analysis as to why the data was not normally distributed. The box plot for the petal widths shows the presence of outliers on the upper end of the Setosa measurments. Note that the data presented by UCI contains two errors in the 35th and 38th  (entries 34 and 37 in appendex 1 ) sample both of which affect the Iris Setosa dimension petal width, with another transcription error in the Setosa’s petal widths for data point 38 (37 in appendex 1). It would be useful to repeat this test with outliers removed and data corrected to see if t-test criteria would then be satisfied. It would also be useful to do an analysis of variance ANOVA on the data. Similarly no t-test was performed between the Setosa and Virginica petal widths as normal distribution criteria was not satisfied. Again this could be due to outliers and errors in the Setosa data.

Petal length tests were more conclusive. Setosa and Versicolor Welch’s t-test was significant suggesting they came from different normal distributions. Significant differences were found when the Setosa was tested against Virginica petal lengths. The Versicolor and Virginica also showed significate difference in means with greater degrees of freedom than with the setosa petal lengths.

In sum, the mean sepal widths were significantly different across all species, with the Setosa (3.42cm) being larger than the Virginica (2.97cm) which in turn is larger than the Versicolor (2.77cm). Sepal length means were also significantly different with the setosa having the smallest sepal length (5.01cm), then the Versicolor (5.94cm) and Virginica (6.59cm) with the largest measure. This suggests that the flower could be identified by the either its sepal length or width. Petal widths were not as good an indicator of Iris species since the Setosa appeared not to follow a normal distribution. However it was possible to differentiate between the Virginica (2.03cm) and Versicolor (1.33cm) species. Petal lengths were also useful in identifying plant species. The mean petal lengths for the Iris species was also useful for identification purposes as the Setosa (1.46cm) had the smallest mean, followed by the Versicolor (4.26cm), with the Virginica (5.55cm) having the largest petal length. Further research could investigate this dataset without outliers. The ratio length:width might also be a useful method for identifying the setosa from the other two species given the relatively large ratio compared to Versicolor and Virginica ratios. This project showed the usefulness and power python can bring to data analysis in performing descriptive, inferential and visual analysis of data.

**References**

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[wiki](https://en.wikipedia.org/wiki/Iris\_flower\_data\_set) [stack exchange](https://stats.stackexchange.com/questions/30788/whats-a-good-way-to-use-r-to-make-a-scatterplot-that-separates-the-data-by-trea/30789#30789) [link](https://stats.stackexchange.com/questions/74776/what-aspects-of-the-Iris-data-set-make-it-so-successful-as-an-example-teaching) [link](https://archive.ics.uci.edu/ml/datasets/Iris) [](https://www.kaggle.com/sridharcr/data-analysis-Iris-dataset) [](https://www.kaggle.com/benhamner/python-data-visualizations) [](http://scikit-learn.org/stable/tutorial/basic/tutorial.html) []() #

**Appendix**

Table 1 The Iris Data Set (measures in cm)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | sepalL | sepalW | petalL | petalW | name |
| 0 | 5.1 | 3.5 | 1.4 | 0.2 | Iris-setosa |
| 1 | 4.9 | 3 | 1.4 | 0.2 | Iris-setosa |
| 2 | 4.7 | 3.2 | 1.3 | 0.2 | Iris-setosa |
| 3 | 4.6 | 3.1 | 1.5 | 0.2 | Iris-setosa |
| 4 | 5 | 3.6 | 1.4 | 0.2 | Iris-setosa |
| 5 | 5.4 | 3.9 | 1.7 | 0.4 | Iris-setosa |
| 6 | 4.6 | 3.4 | 1.4 | 0.3 | Iris-setosa |
| 7 | 5 | 3.4 | 1.5 | 0.2 | Iris-setosa |
| 8 | 4.4 | 2.9 | 1.4 | 0.2 | Iris-setosa |
| 9 | 4.9 | 3.1 | 1.5 | 0.1 | Iris-setosa |
| 10 | 5.4 | 3.7 | 1.5 | 0.2 | Iris-setosa |
| 11 | 4.8 | 3.4 | 1.6 | 0.2 | Iris-setosa |
| 12 | 4.8 | 3 | 1.4 | 0.1 | Iris-setosa |
| 13 | 4.3 | 3 | 1.1 | 0.1 | Iris-setosa |
| 14 | 5.8 | 4 | 1.2 | 0.2 | Iris-setosa |
| 15 | 5.7 | 4.4 | 1.5 | 0.4 | Iris-setosa |
| 16 | 5.4 | 3.9 | 1.3 | 0.4 | Iris-setosa |
| 17 | 5.1 | 3.5 | 1.4 | 0.3 | Iris-setosa |
| 18 | 5.7 | 3.8 | 1.7 | 0.3 | Iris-setosa |
| 19 | 5.1 | 3.8 | 1.5 | 0.3 | Iris-setosa |
| 20 | 5.4 | 3.4 | 1.7 | 0.2 | Iris-setosa |
| 21 | 5.1 | 3.7 | 1.5 | 0.4 | Iris-setosa |
| 22 | 4.6 | 3.6 | 1 | 0.2 | Iris-setosa |
| 23 | 5.1 | 3.3 | 1.7 | 0.5 | Iris-setosa |
| 24 | 4.8 | 3.4 | 1.9 | 0.2 | Iris-setosa |
| 25 | 5 | 3 | 1.6 | 0.2 | Iris-setosa |
| 26 | 5 | 3.4 | 1.6 | 0.4 | Iris-setosa |
| 27 | 5.2 | 3.5 | 1.5 | 0.2 | Iris-setosa |
| 28 | 5.2 | 3.4 | 1.4 | 0.2 | Iris-setosa |
| 29 | 4.7 | 3.2 | 1.6 | 0.2 | Iris-setosa |
| 30 | 4.8 | 3.1 | 1.6 | 0.2 | Iris-setosa |
| 31 | 5.4 | 3.4 | 1.5 | 0.4 | Iris-setosa |
| 32 | 5.2 | 4.1 | 1.5 | 0.1 | Iris-setosa |
| 33 | 5.5 | 4.2 | 1.4 | 0.2 | Iris-setosa |
| 34 | 4.9 | 3.1 | 1.5 | 0.1 | Iris-setosa |
| 35 | 5 | 3.2 | 1.2 | 0.2 | Iris-setosa |
| 36 | 5.5 | 3.5 | 1.3 | 0.2 | Iris-setosa |
| 37 | 4.9 | 3.1 | 1.5 | 0.1 | Iris-setosa |
| 38 | 4.4 | 3 | 1.3 | 0.2 | Iris-setosa |
| 39 | 5.1 | 3.4 | 1.5 | 0.2 | Iris-setosa |
| 40 | 5 | 3.5 | 1.3 | 0.3 | Iris-setosa |
| 41 | 4.5 | 2.3 | 1.3 | 0.3 | Iris-setosa |
| 42 | 4.4 | 3.2 | 1.3 | 0.2 | Iris-setosa |
| 43 | 5 | 3.5 | 1.6 | 0.6 | Iris-setosa |
| 44 | 5.1 | 3.8 | 1.9 | 0.4 | Iris-setosa |
| 45 | 4.8 | 3 | 1.4 | 0.3 | Iris-setosa |
| 46 | 5.1 | 3.8 | 1.6 | 0.2 | Iris-setosa |
| 47 | 4.6 | 3.2 | 1.4 | 0.2 | Iris-setosa |
| 48 | 5.3 | 3.7 | 1.5 | 0.2 | Iris-setosa |
| 49 | 5 | 3.3 | 1.4 | 0.2 | Iris-setosa |
| 50 | 7 | 3.2 | 4.7 | 1.4 | Iris-versicolor |
| 51 | 6.4 | 3.2 | 4.5 | 1.5 | Iris-versicolor |
| 52 | 6.9 | 3.1 | 4.9 | 1.5 | Iris-versicolor |
| 53 | 5.5 | 2.3 | 4 | 1.3 | Iris-versicolor |
| 54 | 6.5 | 2.8 | 4.6 | 1.5 | Iris-versicolor |
| 55 | 5.7 | 2.8 | 4.5 | 1.3 | Iris-versicolor |
| 56 | 6.3 | 3.3 | 4.7 | 1.6 | Iris-versicolor |
| 57 | 4.9 | 2.4 | 3.3 | 1 | Iris-versicolor |
| 58 | 6.6 | 2.9 | 4.6 | 1.3 | Iris-versicolor |
| 59 | 5.2 | 2.7 | 3.9 | 1.4 | Iris-versicolor |
| 60 | 5 | 2 | 3.5 | 1 | Iris-versicolor |
| 61 | 5.9 | 3 | 4.2 | 1.5 | Iris-versicolor |
| 62 | 6 | 2.2 | 4 | 1 | Iris-versicolor |
| 63 | 6.1 | 2.9 | 4.7 | 1.4 | Iris-versicolor |
| 64 | 5.6 | 2.9 | 3.6 | 1.3 | Iris-versicolor |
| 65 | 6.7 | 3.1 | 4.4 | 1.4 | Iris-versicolor |
| 66 | 5.6 | 3 | 4.5 | 1.5 | Iris-versicolor |
| 67 | 5.8 | 2.7 | 4.1 | 1 | Iris-versicolor |
| 68 | 6.2 | 2.2 | 4.5 | 1.5 | Iris-versicolor |
| 69 | 5.6 | 2.5 | 3.9 | 1.1 | Iris-versicolor |
| 70 | 5.9 | 3.2 | 4.8 | 1.8 | Iris-versicolor |
| 71 | 6.1 | 2.8 | 4 | 1.3 | Iris-versicolor |
| 72 | 6.3 | 2.5 | 4.9 | 1.5 | Iris-versicolor |
| 73 | 6.1 | 2.8 | 4.7 | 1.2 | Iris-versicolor |
| 74 | 6.4 | 2.9 | 4.3 | 1.3 | Iris-versicolor |
| 75 | 6.6 | 3 | 4.4 | 1.4 | Iris-versicolor |
| 76 | 6.8 | 2.8 | 4.8 | 1.4 | Iris-versicolor |
| 77 | 6.7 | 3 | 5 | 1.7 | Iris-versicolor |
| 78 | 6 | 2.9 | 4.5 | 1.5 | Iris-versicolor |
| 79 | 5.7 | 2.6 | 3.5 | 1 | Iris-versicolor |
| 80 | 5.5 | 2.4 | 3.8 | 1.1 | Iris-versicolor |
| 81 | 5.5 | 2.4 | 3.7 | 1 | Iris-versicolor |
| 82 | 5.8 | 2.7 | 3.9 | 1.2 | Iris-versicolor |
| 83 | 6 | 2.7 | 5.1 | 1.6 | Iris-versicolor |
| 84 | 5.4 | 3 | 4.5 | 1.5 | Iris-versicolor |
| 85 | 6 | 3.4 | 4.5 | 1.6 | Iris-versicolor |
| 86 | 6.7 | 3.1 | 4.7 | 1.5 | Iris-versicolor |
| 87 | 6.3 | 2.3 | 4.4 | 1.3 | Iris-versicolor |
| 88 | 5.6 | 3 | 4.1 | 1.3 | Iris-versicolor |
| 89 | 5.5 | 2.5 | 4 | 1.3 | Iris-versicolor |
| 90 | 5.5 | 2.6 | 4.4 | 1.2 | Iris-versicolor |
| 91 | 6.1 | 3 | 4.6 | 1.4 | Iris-versicolor |
| 92 | 5.8 | 2.6 | 4 | 1.2 | Iris-versicolor |
| 93 | 5 | 2.3 | 3.3 | 1 | Iris-versicolor |
| 94 | 5.6 | 2.7 | 4.2 | 1.3 | Iris-versicolor |
| 95 | 5.7 | 3 | 4.2 | 1.2 | Iris-versicolor |
| 96 | 5.7 | 2.9 | 4.2 | 1.3 | Iris-versicolor |
| 97 | 6.2 | 2.9 | 4.3 | 1.3 | Iris-versicolor |
| 98 | 5.1 | 2.5 | 3 | 1.1 | Iris-versicolor |
| 99 | 5.7 | 2.8 | 4.1 | 1.3 | Iris-versicolor |
| 100 | 6.3 | 3.3 | 6 | 2.5 | Iris-virginica |
| 101 | 5.8 | 2.7 | 5.1 | 1.9 | Iris-virginica |
| 102 | 7.1 | 3 | 5.9 | 2.1 | Iris-virginica |
| 103 | 6.3 | 2.9 | 5.6 | 1.8 | Iris-virginica |
| 104 | 6.5 | 3 | 5.8 | 2.2 | Iris-virginica |
| 105 | 7.6 | 3 | 6.6 | 2.1 | Iris-virginica |
| 106 | 4.9 | 2.5 | 4.5 | 1.7 | Iris-virginica |
| 107 | 7.3 | 2.9 | 6.3 | 1.8 | Iris-virginica |
| 108 | 6.7 | 2.5 | 5.8 | 1.8 | Iris-virginica |
| 109 | 7.2 | 3.6 | 6.1 | 2.5 | Iris-virginica |
| 110 | 6.5 | 3.2 | 5.1 | 2 | Iris-virginica |
| 111 | 6.4 | 2.7 | 5.3 | 1.9 | Iris-virginica |
| 112 | 6.8 | 3 | 5.5 | 2.1 | Iris-virginica |
| 113 | 5.7 | 2.5 | 5 | 2 | Iris-virginica |
| 114 | 5.8 | 2.8 | 5.1 | 2.4 | Iris-virginica |
| 115 | 6.4 | 3.2 | 5.3 | 2.3 | Iris-virginica |
| 116 | 6.5 | 3 | 5.5 | 1.8 | Iris-virginica |
| 117 | 7.7 | 3.8 | 6.7 | 2.2 | Iris-virginica |
| 118 | 7.7 | 2.6 | 6.9 | 2.3 | Iris-virginica |
| 119 | 6 | 2.2 | 5 | 1.5 | Iris-virginica |
| 120 | 6.9 | 3.2 | 5.7 | 2.3 | Iris-virginica |
| 121 | 5.6 | 2.8 | 4.9 | 2 | Iris-virginica |
| 122 | 7.7 | 2.8 | 6.7 | 2 | Iris-virginica |
| 123 | 6.3 | 2.7 | 4.9 | 1.8 | Iris-virginica |
| 124 | 6.7 | 3.3 | 5.7 | 2.1 | Iris-virginica |
| 125 | 7.2 | 3.2 | 6 | 1.8 | Iris-virginica |
| 126 | 6.2 | 2.8 | 4.8 | 1.8 | Iris-virginica |
| 127 | 6.1 | 3 | 4.9 | 1.8 | Iris-virginica |
| 128 | 6.4 | 2.8 | 5.6 | 2.1 | Iris-virginica |
| 129 | 7.2 | 3 | 5.8 | 1.6 | Iris-virginica |
| 130 | 7.4 | 2.8 | 6.1 | 1.9 | Iris-virginica |
| 131 | 7.9 | 3.8 | 6.4 | 2 | Iris-virginica |
| 132 | 6.4 | 2.8 | 5.6 | 2.2 | Iris-virginica |
| 133 | 6.3 | 2.8 | 5.1 | 1.5 | Iris-virginica |
| 134 | 6.1 | 2.6 | 5.6 | 1.4 | Iris-virginica |
| 135 | 7.7 | 3 | 6.1 | 2.3 | Iris-virginica |
| 136 | 6.3 | 3.4 | 5.6 | 2.4 | Iris-virginica |
| 137 | 6.4 | 3.1 | 5.5 | 1.8 | Iris-virginica |
| 138 | 6 | 3 | 4.8 | 1.8 | Iris-virginica |
| 139 | 6.9 | 3.1 | 5.4 | 2.1 | Iris-virginica |
| 140 | 6.7 | 3.1 | 5.6 | 2.4 | Iris-virginica |
| 141 | 6.9 | 3.1 | 5.1 | 2.3 | Iris-virginica |
| 142 | 5.8 | 2.7 | 5.1 | 1.9 | Iris-virginica |
| 143 | 6.8 | 3.2 | 5.9 | 2.3 | Iris-virginica |
| 144 | 6.7 | 3.3 | 5.7 | 2.5 | Iris-virginica |
| 145 | 6.7 | 3 | 5.2 | 2.3 | Iris-virginica |
| 146 | 6.3 | 2.5 | 5 | 1.9 | Iris-virginica |
| 147 | 6.5 | 3 | 5.2 | 2 | Iris-virginica |
| 148 | 6.2 | 3.4 | 5.4 | 2.3 | Iris-virginica |
| 149 | 5.9 | 3 | 5.1 | 1.8 | Iris-virginica |