A4Q1

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1 CMPT 423/820

1.1 Assignment 4 Question 1

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```
In [8]: import pandas as pd
        import numpy as np

        iris = pd.read_csv('data/A4Q1/iris.csv',
                           header=None,
                           names=['SepalLengthCm', 'SepalWidthCm',
                                  'PetalLengthCm', 'PetalWidthCm', 'Species'])

        iris_1 = pd.read_csv('data/A4Q1/iris01.csv').drop(['Unnamed: 0'], axis = 1)
        iris_5 = pd.read_csv('data/A4Q1/iris05.csv').drop(['Unnamed: 0'], axis = 1)
        iris_10 = pd.read_csv('data/A4Q1/iris10.csv').drop(['Unnamed: 0'], axis = 1)
        iris_20 = pd.read_csv('data/A4Q1/iris20.csv').drop(['Unnamed: 0'], axis = 1)

        data_list = [iris, iris_1, iris_5, iris_10, iris_20]
        class_list = [0,1,5,10,20]
```

1.1.1 Classifier

I choose *Naive Bayes* classifier for this purpose because we have thoroughly investigated the application of NB on the Iris dataset. The following function implements a *Gaussian Naive Bayes* classifier and calculated 10-fold cross-validation on the given dataset.

```
In [9]: from sklearn.naive_bayes import GaussianNB
        from sklearn.model_selection import cross_val_score

        KFOLDS = 10

        def nb_classifier(data_in, label_in):
            """
            :purpose: This function creates an NB classifier and calculates
```

```
        its cross validated accuracy
        :param data_in: dataset
        :param label_in: true answers for the dataset
        :return: the accuracy of the model with 5 point accuracy
        """
        clf_nb = GaussianNB()

        # fitting the model to the data
        clf_nb.fit(data_in, label_in)

        result = cross_val_score(clf_nb, data_in,
                         label_in,
                         cv=KFOLDS,
                         scoring='accuracy')

        return round(result.mean(),5)
```

```
In [10]: # creating dataframe for saving results

    result = pd.DataFrame(columns=['method', 'miss percentage', 'accuracy'])

    def result_finder(data_list_in, result_in, function, string):
        """
        :purpose: This function operates function on
        the data list and return the result dataframe
        :param data_list_in: list of datasets
        :param result_in: result dataframe
        :param function: given function for modelling
        :param string: filling method
        :return: the result dataframe
        """
        # finding accuracy for each dataset
        miss_acc = [string]
        for i in range(len(data_list_in)):
            miss_acc = [string, class_list[i],function(data_list_in[i])]
            result_in = result_in.append(pd.Series(miss_acc,
                                                   index = result_in.columns),
                                         ignore_index=True)

        # add to result dataframe
        return result_in
```

1. Remove any sample (row) with missing data.

```
In [11]: def omit_row_classifier(data_in):
             """
             :purpose: This function omit rows with NA value and
             return the learned guassian classifier accuracy
```

```
            :param data_in: dataset
            :return: the accuracy of the model with 5 point accuracy
            """
            removed_data = data_in.dropna()

            labels = removed_data.values[:, 4]
            data = removed_data.values[:, :4]

            return nb_classifier(data, labels)
```

```
In [12]: result = result_finder(data_list,
                               result,
                               omit_row_classifier,
                               'remove')
```

2. Fill in any missing data with a random value. Use the range (min, max) of the feature as the range for your random value.

```
In [13]: from random import uniform

         def random_row_classifier(data_in):
             """
             :purpose: This function fill rows with NA value
             with random value
             return the learned guassian classifier accuracy
             :param data_in: dataset
             :return: the accuracy of the model with 5 point accuracy
             """
             labels = data_in.values[:, 4]

             removed_data = data_in.drop(['Species'], axis = 1)
             removed_data = removed_data.transform(
                 lambda v: v.fillna(round(uniform(np.min(v),
                                                  np.max(v)), 2)))

             data = removed_data.values

             return nb_classifier(data, labels)
```

```
In [14]: result = result_finder(data_list,
                               result,
                               random_row_classifier,
                               'random')
```

3. Fill in the missing data with the mean value for the feature, regardless of class label.

```
In [15]: def mean_feature_row_classifier(data_in):
             """
```

```
            :purpose: This function fill rows with NA value
            with mean feature value
            return the learned guassian classifier accuracy
            :param data_in: dataset
            :return: the accuracy of the model with 5 point accuracy
            """
            removed_data = data_in.fillna(data_in.mean())

            labels = removed_data.values[:, 4]
            data = removed_data.values[:, :4]

            return nb_classifier(data, labels)
```

```
In [16]: result = result_finder(data_list,
                               result,
                               mean_feature_row_classifier,
                               'mean feature')
```

4. Fill in the missing data with the mean value for the feature, given the class. For example, if the missing value appears on a row with class label L, then use the mean value of that feature, limiting the calculation to rows having label L.

```
In [17]: def mean_group_feature_row_classifier(data_in):
            """
            :purpose: This function fill rows with NA value
            with mean feature value
            return the learned guassian classifier accuracy
            :param data_in: dataset
            :return: the accuracy of the model with 5 point accuracy
            """
            labels = data_in.values[:, 4]

            removed_data = data_in.groupby('Species').transform(
                lambda grp: grp.fillna(np.mean(grp)))

            data = removed_data.values

            return nb_classifier(data, labels)
```

```
In [18]: result = result_finder(data_list,
                               result,
                               mean_group_feature_row_classifier,
                               'label mean feature')
         result
```

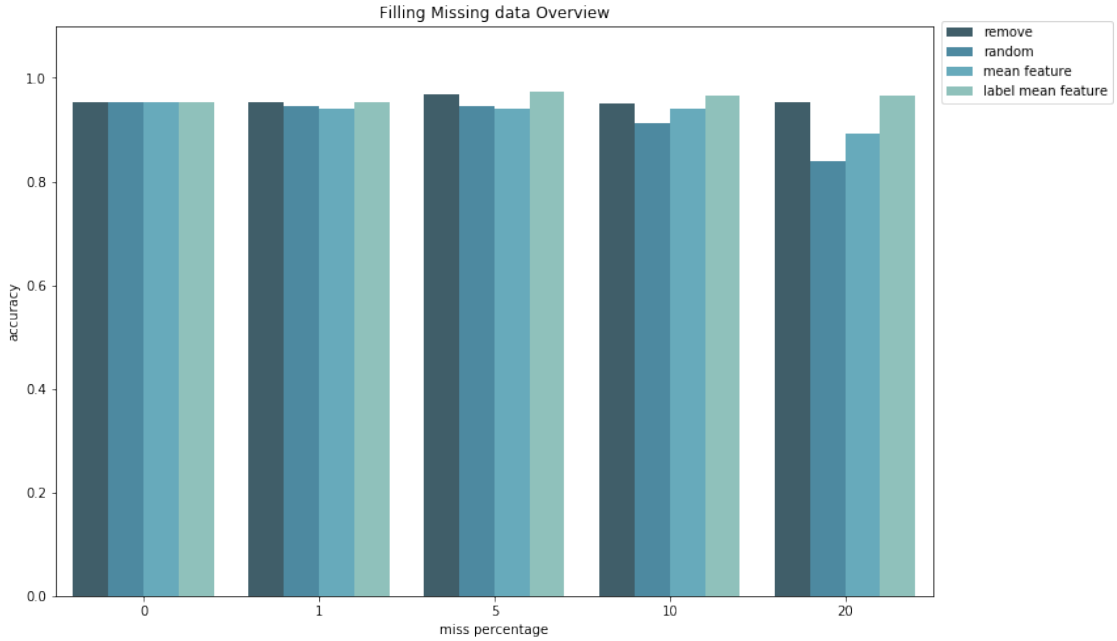
Out[18]:

	method	miss percentage	accuracy
0	remove	0	0.95333
1	remove	1	0.95238

```
2                remove                5   0.96786
3                remove               10   0.95091
4                remove               20   0.95417
5                random                0   0.95333
6                random                1   0.94667
7                random                5   0.94667
8                random               10   0.91333
9                random               20   0.84000
10        mean feature                 0   0.95333
11        mean feature                 1   0.94000
12        mean feature                 5   0.94000
13        mean feature                10   0.94000
14        mean feature                20   0.89333
15  label mean feature                 0   0.95333
16  label mean feature                 1   0.95333
17  label mean feature                 5   0.97333
18  label mean feature                10   0.96667
19  label mean feature                20   0.96667
```

Plotting

```
In [25]: import seaborn as sns
         import matplotlib.pyplot as plt

         plt.figure(figsize=(12,8))

         ax = sns.barplot(data = result,
                     x = 'miss percentage',
                     y = 'accuracy',
                     hue = 'method',
                     palette="GnBu_d")

         ax.set(ylim=(0, 1.1), title='Filling Missing data Overview')

         ax.legend(bbox_to_anchor= (1.01, 1.01), ncol=1,
                     borderaxespad=0)

Out[25]: <matplotlib.legend.Legend at 0x1a21696650>
```



As we can see, the accuracy of the model decreases as we delete more data. Furthermore, filling with label-based feature average is more precise than feature-based average, and filling with random value has the lease accuracy. Because filling with average doesn't add any outlier, especially concerning the label that doesn't change the group feature mean and doesn't have an adverse effect on the existing data in the dataset. In contrast, filling with random values might shift the mean of feature, which would impact the original dataset characteristics.