Question No 1:

Provide responses to the following questions about the dataset.

Answer:

1. How many instances does the dataset contain?

   Number of instances: 110

2. How many input attributes does the dataset contain?

   Number of input attributes: 7

3. How many possible values does the output attribute have?

   Number of possible values for the output attribute: 2

4. How many input attributes are categorical?

   Number of categorical input attributes: 4

5. What is the class ratio (male vs female) in the dataset?

   Class ratio (male vs female): Male: 56.36% , Female: 43.64%

Question No 2:

Apply Logistic Regression, Support Vector Machines, and Multilayer Perceptron classification algorithms (using Python) on the gender prediction dataset with 2/3 train and 1/3 test split ratio and answer the following questions.

Answer:

1. How many instances are incorrectly classified?

   Logistic Regression Incorrectly Classified Instances: 0

   SVM Incorrectly Classified Instances: 9

   MLP Incorrectly Classified Instances: 5

2. Rerun the experiment using train/test split ratio of 80/20. Do you see any change in the results? Explain.

   Logistic Regression Incorrectly Classified Instances: 0

   SVM Incorrectly Classified Instances: 4

   MLP Incorrectly Classified Instances: 12

There's no change in the number of incorrectly classified instances between the 66/33 split and 80/20 split. The number of incorrectly classified instances increased from 9 in the 66/33 split to 4 in the 80/20 split. The number of incorrectly classified instances changed each time for both splits.

Sure, changing the test split ratio from 0.33 to 0.2 alters the proportion of data used for training and testing. A 0.33 split dedicates more data for training (67%) and more for testing (33%), potentially allowing for better learning and comprehensive evaluation. Conversely, a 0.2 split allocates less data for testing (20%) and more for training (80%), which might lead to less comprehensive model evaluation and potentially less robust learning due to a smaller training set. This change affects model performance metrics, bias-variance trade-offs, and the reliability of the model's generalization to unseen data.

3. Name 2 attributes that you believe are the most “powerful” in the prediction task. Explain why?

   Top 2 influential attributes:

   beard 1.300722

   hair_length 0.715132

4. Try to exclude these 2 attribute(s) from the dataset. Rerun the experiment (using 80/20 train/test split), did you find any change in the results? Explain.

   scarf 1.084054

   eye_color 0.970366

Question No 3:

Apply Random Forest classification algorithm (using Python) on the gender prediction dataset with Monte Carlo cross-validation and Leave P-Out cross-validation. Report F1 scores for both cross-validation strategies.

Note: You are free to choose any parameter values for both cross-validation strategies, however, you have to provide these values in your submission document.

Answer:

Monte Carlo F1 scores: 0.9723409605230073

Leave P-Out F1 scores: 0.7731843575418994

Question No 4:

Add 10 sample instances into the dataset (you can ask your friends/relatives/sibling for the data). Run the ML experiment (using Python) by training the model using Gaussian Naïve Bayes classification algorithm and all the instances from the gender prediction dataset. Evaluate the trained model using the newly added 10 test instances. Report accuracy, precision, and recall scores. Note: You must use all the instances in the gender precision dataset for training and only 10 new instances for testing. You must include all the 10 test instances in your assignment submission document.

Answer:

Sample Instances:

```
new_instances = {
    'height': [72, 67, 69, 68, 66, 64, 73, 75, 63, 70],
    'weight': [168, 142, 150, 155, 135, 125, 180, 190, 120, 175],
    'beard': ['yes', 'no', 'yes', 'no', 'no', 'no', 'yes', 'yes', 'no', 'yes'],
    'hair_length': ['short', 'bald', 'medium', 'long', 'long', 'long', 'short', 'medium', 'medium', 'medium'],
    'shoe_size': [43, 40, 42, 38, 37, 36, 44, 45, 39, 42],
    'scarf': ['no', 'no', 'yes', 'yes', 'yes', 'yes', 'no', 'no', 'no', 'no'],
    'eye_color': ['brown', 'blue', 'brown', 'green', 'gray', 'gray', 'black', 'black', 'green', 'black'],
    'gender': ['male', 'female', 'male', 'female', 'female', 'female', 'male', 'male', 'female', 'male']
}
```

Consusion Matrix:

```
 [[4 1]
 [1 4]]
```

Accuracy: 80.0%

Precision: 0.8

Recall: 0.8