**Machine Learning: Classification Algorithms- Report**

1. **Random Forest Algorithm:**

(i)What will be the overall performance of the algorithm?

**Accuracy**= Tp+TN  / (Tp+TN  +FP+FN) = 0.90

(ii)What will be the correct classification of not purchased?

**Recall**(Not purchased)= TP/(TP+FN) = 0.92

(iii) What will be the correct classification of purchased?

**Recall**(Purchased)= TN/(TP+ FP) = 0.88

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

**Precision**(not purchased)= TP /( TP + FP) = 0.93

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

**Precision**(purchased) = TN /( TN + FN) = 0.86

(vi) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

**F1 score(np)** = 2\*(Precision(np)\*Recall(np)/Precision(np)+Recall(np))= 0.92

(vii) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

**F1 score(purchased)** = 2\*(Precision(p)\*Recall(p)/Precision(p)+Recallnp))=0.87

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly

classified)

**MA(Precision)=**Precision(purchased)\*(Total no of not purchased/Overall total)+

Precision(not purchased)\*(Total no of purchased/Overall total) = 0.89

**MA(Recall)=**Recall(purchased)\*(Total no of not purchased/Overall total)+

Recall(not purchased)\*(Total no of purchased/Overall total) = 0.90

**MA(Precision)**=F1score(purchased)\*(Total no of not purchased/Overall total)+

F1score(not purchased)\*(Total no of purchased/Overall total) = 0.89

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.90

WA(Recall) = 0.90

WA(F1 score) =0.90

(x) **Support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

1. **Decision Tree Algorithm**:

(i)What will be the overall performance of the algorithm?

**Accuracy**= Tp+TN  / (Tp+TN  +FP+FN) = 0.87

(ii)What will be the correct classification of not purchased?

**Recall**(Not purchased)= TP/(TP+FN) = 0.89

(iii) What will be the correct classification of purchased?

**Recall**(Purchased)= TN/(TP+ FP) = 0.84

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

**Precision**(not purchased)= TP /( TP + FP) = 0.90

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

**Precision**(purchased) = TN /( TN + FN) = 0.82

(vi) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

**F1 score(np)** = 2\*(Precision(np)\*Recall(np)/Precision(np)+Recall(np))= 0.90

(vii) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

**F1 score(purchased)** = 2\*(Precision(p)\*Recall(p)/Precision(p)+Recallnp))=0.83

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified)

**MA(Precision)=**Precision(purchased)\*(Total no of not purchased/Overall total)+

Precision(not purchased)\*(Total no of purchased/Overall total) = 0.86

**MA(Recall)=**Recall(purchased)\*(Total no of not purchased/Overall total)+

Recall(not purchased)\*(Total no of purchased/Overall total) = 0.87

**MA(Precision)**=F1score(purchased)\*(Total no of not purchased/Overall total)+

F1score(not purchased)\*(Total no of purchased/Overall total) = 0.86

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.87

WA(Recall) = 0.87

WA(F1 score) =0.87

(x) **Support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

1. **Support Vector Machine Algorithm**

(i)What will be the overall performance of the algorithm?

**Accuracy**= Tp+TN  / (Tp+TN  +FP+FN) = 0.78

(ii)What will be the correct classification of not purchased?

**Recall**(Not purchased)= TP/(TP+FN) = 0.96

(iii) What will be the correct classification of purchased?

**Recall**(Purchased)= TN/(TP+ FP) = 0.47

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

**Precision**(not purchased)= TP /( TP + FP) = 0.76

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

**Precision**(purchased) = TN /( TN + FN) = 0.88

(vi) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

**F1 score(np)** = 2\*(Precision(np)\*Recall(np)/Precision(np)+Recall(np))= 0.85

(vii) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

**F1 score(purchased)** = 2\*(Precision(p)\*Recall(p)/Precision(p)+Recallnp))=0.61

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified) **MA(Precision)=**Precision(purchased)\*(Total no of not purchased/Overall total)+

Precision(not purchased)\*(Total no of purchased/Overall total) = 0.82

**MA(Recall)=**Recall(purchased)\*(Total no of not purchased/Overall total)+

Recall(not purchased)\*(Total no of purchased/Overall total) = 0.72

**MA(Precision)**=F1score(purchased)\*(Total no of not purchased/Overall total)+

F1score(not purchased)\*(Total no of purchased/Overall total) = 0.73

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.81

WA(Recall) = 0.78

WA(F1 score) =0.76

(x) **support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

1. **Logistic Regression Algorithm**

(i)What will be the overall performance of the algorithm?

**Accuracy**= Tp+TN  / (Tp+TN  +FP+FN) = 0.63

(ii)What will be the correct classification of not purchased?

**Recall**(Not purchased)= TP/(TP+FN) = 1.00

(iii) What will be the correct classification of purchased?

**Recall**(Purchased)= TN/(TP+ FP) = 0.00

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

**Precision**(not purchased)= TP /( TP + FP) = 0.63

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

**Precision**(purchased) = TN /( TN + FN) = 0.00

(vi) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

**F1 score(np)** = 2\*(Precision(np)\*Recall(np)/Precision(np)+Recall(np))= 0.78

(vii) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

**F1 score(purchased)** = 2\*(Precision(p)\*Recall(p)/Precision(p)+Recallnp))=0.00

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified) **MA(Precision)=**Precision(purchased)\*(Total no of not purchased/Overall total)+

Precision(not purchased)\*(Total no of purchased/Overall total) = 0.32

**MA(Recall)=**Recall(purchased)\*(Total no of not purchased/Overall total)+

Recall(not purchased)\*(Total no of purchased/Overall total) = 0.50

**MA(Precision)**=F1score(purchased)\*(Total no of not purchased/Overall total)+

F1score(not purchased)\*(Total no of purchased/Overall total) = 0.39

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.40

WA(Recall) = 0.63

WA(F1 score) =0.49

(x) **Support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

**5.KNN Algorithm**

(i)What will be the overall performance of the algorithm?

**Accuracy**= Tp+TN  / (Tp+TN  +FP+FN) = 0.84

(ii)What will be the correct classification of not purchased?

**Recall**(Not purchased)= TP/(TP+FN) = 0.93

(iii) What will be the correct classification of purchased?

**Recall**(Purchased)= TN/(TP+ FP) = 0.67

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

**Precision**(not purchased)= TP /( TP + FP) = 0.83

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

**Precision**(purchased) = TN /( TN + FN) = 0.85

(vi) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

**F1 score(np)** = 2\*(Precision(np)\*Recall(np)/Precision(np)+Recall(np))= 0.88

(vii) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

**F1 score(purchased)** = 2\*(Precision(p)\*Recall(p)/Precision(p)+Recallnp))=0.75

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified)

**MA(Precision)=**Precision(purchased)\*(Total no of not purchased/Overall total)+

Precision(not purchased)\*(Total no of purchased/Overall total) = 0.84

**MA(Recall)=**Recall(purchased)\*(Total no of not purchased/Overall total)+

Recall(not purchased)\*(Total no of purchased/Overall total) = 0.80

**MA(Precision)**=F1score(purchased)\*(Total no of not purchased/Overall total)+

F1score(not purchased)\*(Total no of purchased/Overall total) = 0.81

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.84

WA(Recall) = 0.84

WA(F1 score) =0.83

(x) **Support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

1. **Naives Bayes Algorithm (given in table below)**

(i)What will be the overall performance of the algorithm?

**Accuracy**= Tp+TN  / (Tp+TN  +FP+FN)

(ii)What will be the correct classification of not purchased?

**Recall**(Not purchased)= TP/(TP+FN)

(iii) What will be the correct classification of purchased?

**Recall**(Purchased)= TN/(TP+ FP)

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

**Precision**(not purchased)= TP /( TP + FP)

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

**Precision**(purchased) = TN /( TN + FN)

(vi) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

**F1 score(np)** = 2\*(Precision(np)\*Recall(np)/Precision(np)+Recall(np))

(vii) F1 Measure( Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

**F1 score(purchased)** = 2\*(Precision(p)\*Recall(p)/Precision(p)+Recallnp))

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified)

**MA(Precision)=**Precision(purchased)\*(Total no of not purchased/Overall total)+

Precision(not purchased)\*(Total no of purchased/Overall total)

**MA(Recall)=**Recall(purchased)\*(Total no of not purchased/Overall total)+

Recall(not purchased)\*(Total no of purchased/Overall total)

**MA(Precision)**=F1score(purchased)\*(Total no of not purchased/Overall total)+

F1score(not purchased)\*(Total no of purchased/Overall total)

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision)

WA(Recall)

WA(F1 score) =

(x) **support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

**Comparison table for all Naives Bayes Algorithm**:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | Multinomial NB | Bernoulli NB | Categorical NB | Complement NB |
| Accuracy | 0.63 | 0.63 | 0.84 | 0.51 |
| Recall(not purchased) | 1.00 | 1.00 | 0.96 | 0.55 |
| Recall(purchased) | 0.00 | 0.00 | 0.63 | 0.47 |
| Precision(not purchased) | 0.63 | 0.63 | 0.82 | 0.67 |
| Precision( purchased) | 0.00 | 0.00 | 0.91 | 0.39 |
| F1 score(not purchased) | 0.78 | 0.78 | 0.89 | 0.55 |
| F1 score( purchased) | 0.00 | 0.00 | 0.75 | 0.47 |
| Macro Avg (Precision) | 0.32 | 0.32 | 0.87 | 0.53 |
| Macro Avg (Precision) | 0.50 | 0.50 | 0.80 | 0.53 |
| Macro Avg (Precision) | 0.39 | 0.39 | 0.82 | 0.51 |
| Weighted Avg (Precision) | 0.40 | 0.40 | 0.85 | 0.57 |
| Weighted Avg (Precision) | 0.63 | 0.63 | 0.84 | 0.51 |
| Weighted Avg (Precision) | 0.49 | 0.49 | 0.84 | 0.52 |